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Journal of the Society of Arts.

FRIDAY, NOVEMBER 28, 1862.

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NOTICE TO MEMBERS.

General Index.

A general Index to the first ten volumes of the *Journal* will shortly be published, which should be bound with the present volume. Members who desire to have copies are requested to apply to the Secretary as early as possible, in order that a sufficient number may be printed.

EXAMINATIONS, 1863. — NOTICE TO INSTITUTIONS AND LOCAL BOARDS.

The attention of Secretaries of Institutions and Local Educational Boards is specially called to the following extract from the programme of examinations for 1863:—

> 5. A detailed list of the chairman, secretary, and other members of each Local Board, giving not only their names but their addresses and designations, should be submitted to the Council of the Society of Arts before the 1st of January, 1863. In some cases the Local Educational Boards comprise such large districts that, for the convenience of the Candidates, Branch Local Boards have to be formed within the Districts. Whenever this is the case, the names and addresses of the members, both of District Board and of its Branch Boards must be forwarded to the Secretary of the Society of Arts. All changes in the composition of the various Boards now in existence, or to be formed hereafter, should be immediately notified to the Society of Arts.

SOCIETY'S PRIZE WRITING CASE.

It will be in the recollection of members that in the Session of 1858-9, a Prize was awarded to Messrs. Parkins and Gotto for a writing case to be sold to the public at 1s. 6d. or 2s. fitted, and of which a very large number have been disposed of.

The Council have pleasure in announcing that this has led to the production of other writing cases of a somewhat similar character, and Messrs. Partridge and Cozens, of Fleet-street, have brought one under their notice which appears to be conveniently and usefully arranged, and which is sold, fitted, at 1s. 6d.

SECOND ORDINARY MEETING.

Wednesday, November 26, 1862.

The Second Ordinary Meeting of the One Hundred and Ninth Session was held on Wednesday, the 26th inst., Dr. A. W. Williamson, F.R.S., Professor of Chemistry, University College, London, in the chair.

The following candidates were proposed for election as members of the Society:—

Avery, Joseph	81, Great Portland-street, W.
Bowman, George	(J. Bowman and Son), Langholm.
Brown, Alfred	115, Whitechapel, E.
Canton, Edwin, F.R.C.S.	30, Montague-place, Russell-square, W.C.
Crichley, Henry	Bromfield House, Birmingham.
Duppa, Duppa	Longville, Wistanstow, Shropshire.
Edwards, Charles Stuart.	64, Friday-street, E.C.
Fenton, Hugh	Queen's Ferry Wire Rope Works, near Flint, North Wales.
Geary, John	Prince of Wales-road, Kentish-town, N.W.
Goss, W. H.	Stoke-on-Trent.
Gregory, Henry	Herne-hill, Dulwich, S.
Hamilton, Edward	500, Oxford-street, W.C.
Hobbs, Thomas	15, Earl's-court-gardens, Old Brompton, S.W.
Hutton, John	10, Mark-lane, E.C.
Klaber, Herrman	Albion-pl., London-wall, E.C.
Knewstub, Fabian	33, St. James's-street, S.W.
Launspack, Louis	9, Upper Berkeley-st. West, Hyde-park, W.
Mathews, George	Upper Russell-street, Bermondsey, S.E.
McDougall, Archibald	11, Upper Thames-street, E.C.
McLachlan, James	35, St. James's-street, S.W.
Mitford, Bertram	Cheltenham.
Moore, Charles	Rose Hill, Swansea.
Morant, Robert	91, New Bond-street, W.
Norris, J.	36, Little Russell-street, W.C.
Pilcher, W. F.	Morgan's-lane, Tooley-st. E.C.
Quarm, Thomas	Rose-villa, St. John's-road, Brixton, S.
Radclyffe, Leopold Henry	30, Hanway-street, Oxford-street, W.
Rivière, Robert	196, Piccadilly, W.
Scott, Henry D.	Market-place, Boston, Lincolnshire
Scott, Robson J.	8, Whitefriars-street, E.C.
Shaw, James	2, Royal Exchange-ct., Glasgow, and 150, Leadenhall-street, E.C.
Smith, Charles	43, Upper Baker-street, N.W.
Smithers, H. W	6, Coborn-terrace, Rye-lane, Peckham, S.E.
Stephenson, James	Patent Wire Rope Works, Millwall, E.
Thompson, Henry	Albert-cottage, Weybridge-heath, Surrey.
Watkins, Herbert	215, Regent-street, W.
Willans, Jacob Geoghegan	Belfast, Ireland, and 9, Phillimore-terrace, Kensington, W.
Willoughby, d'Eresby, Lord	142, Piccadilly, W.
Wood, Wm. Robert	Carlisle-house, Brighton.

The following Institution has been received into Union since the last announcement:—

Metropolitan Association for promoting the Education of Adults.

Previously to the reading of the Paper the Secretary called attention to some specimens of a substance proposed as a substitute for cotton. A description will be found at page 48.

The Paper read was—

ON THE UTILIZATION OF PEAT, WITH REFERENCE MORE PARTICULARLY TO THE MANUFACTURE OF HYDRO-CARBON OILS.

By B. H. Paul, Ph.D.

The application of peat to some useful purpose, is a subject which has at various times attracted considerable attention; a vast amount of inventive ingenuity has been bestowed upon it; it has given rise to very sanguine, and I may say, in some cases, very exaggerated expectations, and as a natural consequence it has been a source of proportionate disappointment. Notwithstanding the numerous attempts and proposals that have been made for utilizing peat, very little has been done as to inquiring into and elucidating what are really its capabilities and disabilities as a material for use in the arts. But a knowledge of these circumstances is an essential preliminary to any successful application of it, and I hope to be able, in some degree, to contribute to the acquisition of such a knowledge by bringing before this Society the results of several years' practical experience in the prosecution of this subject.

Taking it for granted that the existence of enormous deposits of peat in various parts of the kingdom is sufficiently well known, and having regard more especially to its technical value, it will be unnecessary for me to enter into any consideration of the origin and formation of peat, or of the different views entertained on that subject. It will be sufficient for my purpose to consider peat as it exists now; and with regard to this point there are two modes in which it occurs, which I believe to be of importance as regards its application to useful purposes. In one case we find peat deposits in the form of what are called peat-bogs, masses of peat of considerable superficial extent, and generally of great depth, 20, 30, and sometimes upwards of 100 feet deep, where the uppermost layers are of a loose, fibrous, or grassy texture, and saturated with water to such an extent, in some instances, as to be incapable of affording any support to the foot. When the water is drawn off from these bogs by drainage, the peat is generally found to vary in character according to the depth at which it is situated, gradually becoming darker in colour, more compact, and having less evident indications of vegetable structure. At the bottom of such bogs the peat is generally a black pasty mass, of a clayey consistency.

In the other case, we find, situated on the slopes of mountainous country, peat deposits, which are never of very great depth, generally from 12 to 2 feet, and where the peat is sufficiently solid to be walked upon with ease. In these deposits the peat is of a more uniform texture and character throughout, than in bogs, although there is always a greater or less difference between the peat at the surface and that at the bottom. These deposits of mountain peat are very common in the Highlands of Scotland and in some parts of Ireland.

Mountain peat offers very much greater facilities for cutting than bog peat, and it is generally of much better quality. Bog peat, when dried, has very much the appearance of pressed hay; it rarely has a density of more than 300 or 400—water being 1,000,—and the cubic foot weighs only from 15 to 30 pounds; it would perhaps be useful to distinguish it by the term turf, from the true mountain peat, which when dried is dark brown or quite black, with little or no remains of plants in it; capable of taking a high polish when rubbed, and of a density greater than that of water, the cubic foot weighing from 53 to 78 pounds.

The method of cutting peat in the Highlands of Scotland is very different from that adopted for cutting peat from bogs. In the first place trenches are opened at distances of about ten yards apart; and, according to the nature of the ground, these trenches are made from 50 to 400 or 500 yards long. After removing the surface sod at the places where the trenches are to be cut, for a width of three feet, along the whole line of the trench, the peat cutter digs out the peat with a peculiar-shaped tool, in slices of about a foot square and three or four inches thick. As fast as these slices are cut, another man takes them off the peat iron and throws them on the surface, so as to spread them out as much as possible. In this way prisms of peat, measuring three feet in width and depth are cut out at intervals of ten yards, and the number of slices cut in each trench are just as many as a man can throw on both sides of the trench without shifting his position except from one end of the trench to the other as the cutting advances.

In succeeding years the peat is cut from the two banks thus formed in each trench, to a width of only 18 inches and a depth of three feet. The advantage of this system of cutting is that there is no necessity for removing the peat by barrows to the spreading-ground, a proceeding which is attended with considerable expense for labour. When the peat is cut in this way from a bank 150 yards long, it will give 75 cubic yards of wet peat, and the number of slices into which this is divided will be about 8,000. Then, as the banks are ten yards apart, there are five yards width of drying ground to each bank, or a superficial area of 6,750 square feet to each bank of 150 yards long. Cutting it in this way every year, it would take ten years to remove the whole of the peat to a depth of three feet. As the banks are cut away in successive years the area of spreading-ground on the surface is reduced, and some of the peat has to be spread at the bottom of the trench, the area of which increases as that of the banks' surface is reduced by the cutting.

The peat cut to a width of 18 inches and a depth of three feet, from a bank of 150 yards long, is what is called an iron's work, and the 75 yards of peat so cut yields about ten tons of dry peat, so that to cut seven or eight thousand tons of dry peat would require 750 irons' work, or banks about 64 miles in length, and extending over an area of about one-fifth of a square mile. This area of ground would supply seven or eight thousand tons every year for ten years.

The cutting and spreading of peat in this way forms but a proportion of the cost of the dry peat. A far more considerable portion of its cost results from the labour of collecting the dry peat and bringing it to the place where it is to be used. Herein lies one of the greatest difficulties of employing peat on any very extensive scale. Whatever mode may be adopted for collecting the dried peat to one spot for use, the cost of carriage will increase in proportion to the increase in the quantity of peat consumed at that spot. Thus, for instance, in the case of a factory consuming 7,000 tons annually, it would be requisite to carry the peat, on the average, a distance of one-tenth of a mile; if the quantity consumed were 70,000 tons, it would be requisite to carry it an average distance of half a mile, and if the quantity consumed were 300,000 tons a year, it would have to be carried an average distance of two miles, or a mile and a half, inasmuch as the cutting-ground would extend over an area of eight square miles.

The extent to which this disadvantage affects any particular instance of the use of peat will depend very much on the skill exercised in laying out the ground for cutting the peat and in disposing the banks and tram-roads, or other means for conveying the peat to the place where it is to be used; but it is a disadvantage which can only be reduced by such means within the smallest possible limits, and which is quite inseparable from the use of peat on a large scale.

Another prominent difficulty attending the use of peat consists in obtaining it in a dry state, fit for use as fuel or otherwise. Mountain peat, as it occurs naturally, contains as much as 80 per cent. of water, even when it has been well drained, and bog peat often contains very much more. Consequently, to obtain one ton of dry peat, five tons of material have to be dug and spread, and four tons of water have to be got rid of by evaporation. When mountain peat is cut in slices, as I have described, and spread out on the ground during dry weather, the drying goes on rapidly, the surface of the pieces acquire a kind of skin, which is not wetted again by rain, and the peat, in the course of a week, is sufficiently hardened to be handled; —the pieces are then set up on edge, so that the air may play on both sides, and, in the course of six weeks or two months, they are dry enough to be stacked or heaped up. But, unfortunately, peat districts are generally remarkable for a very moist atmosphere and for a great frequency of rain. In the Highlands of Scotland and in the Hebrides, on the average there is rain four days out of six, and it is only during the months of May, June, and July that you can expect to have any continuance of weather favourable for drying peat. It is necessary, therefore, to obtain the utmost advantage of that period for the drying of the peat, and to do so the peat must all be cut before the end of May at latest. On the other hand, if the peat is cut during frosty weather, and becomes frozen, it crumbles to powder when the thaw comes, and for this reason it is not safe to commence the cutting at all before April or even May. As a rule it might be said that the month of May is the only time available for cutting peat in the Highlands of Scotland, and more especially in the Hebrides, so as, on the one hand, to avoid the destruction of the peat by frost, and on the other hand, to ensure the best possible chance of getting it well dried.

Notwithstanding the general moist condition of the air in those places, the boisterous winds which prevail are very efficacious in drying the peat; and if, during the months of May and early part of June, the peat has got a certain amount of drying, and a skin has formed on the surface of the pieces, it may be considered safe, whatever kind of weather there may be afterwards. It may then remain on the ground, set up in little heaps, till the autumn, and will get the advantage of whatever dry weather there may be. Of course, even in this case, the quality of the peat will depend on the weather, but if the cutting is not finished by the end of May, there is always less probability of getting the peat in good condition.

It will be evident from these circumstances that the cutting of peat, to supply a factory consuming any large quantity, must be an affair requiring considerable management, so as to get the work done in the short space of time available for it, and the difficulty of effecting this increases in proportion to the quantity of peat required to be procured.

Two men working together, one cutting and the other casting the peat, will, in good weather, get through about one iron's work in a day, equivalent to ten tons of dry peat, so that if they were able to work every day during May they would cut from 200 to 300 tons of peat; and to get 10,000 tons cut and spread, 100 men would be required for the whole month; and to get 300,000 tons cut and spread would require 3,000 men to be employed for the whole month. It is unnecessary to dilate upon the difficulty of getting such a large number of men together for the work, and of organising a system for measuring the work done and carrying on the general supervision of the peat cutting on such a large scale, but I may mention that there are circumstances connected with the habits of the people in these districts, which are in some degree favourable to the carrying out of such an operation. The people are almost all fishermen, and the fishing season does not commence until the end of May or June, so that it would be possible to obtain many of these men before they go to the fishing, and thus the inconvenience of employing a large number of men for a short period would not be so great there as it would in most other instances. Moreover, these people are accustomed to hutting themselves with no small degree of comfort, in huts or bothies built of the surface sods of the peat, and they live in these as a rule, throughout the Hebrides, so that a squad of 200 or 300 men find, on the ground where they are going to work, the materials for their encampment, and it is interesting to see the dexterity and quickness with which they construct these bothies.

Having now described the mode of obtaining the peat and pointed out the two great difficulties involved in the supply of a large quantity of it for the purpose of fuel or for any other application, I will now request your attention to the nature of this material when it has been dried, and in the first instance, as regards its application as fuel.

Even in the most favourable seasons the air-dried peat retains a considerable amount of water—from 20 to 30 per cent.—as will be seen from the following results or analyses of different kinds taken from stacks a year old:—

LEWS PEAT.	AIR DRIED.	
	Per centage of water.	Weight of a cubic foot.
		lbs.
1. Light brown fibrous turf ...	40	25
2. Blackish brown fibrous peat .	26 71	53
3. Black peat very dense	25·39	54
4. Black peat very dense	31·60	65
5. Brown peat	28·74	71
6. Brownish black peat	27·76	78

This water cannot be separated from the peat except by kiln drying, but in order to illustrate the effect of this moisture on the value of peat as fuel, I will at first suppose that it has been so dried as not to contain any water. In that state the composition of peat may be taken as generally represented by the following proportions as compared with coal:—

	PEAT	COAL.				
		Welch.	New-castle.	Lanca-shire.	Scotch.	Derby-shire.
Carbon.......	60	83·78	82·12	77·90	78·53	79·68
Hydrogen ...	6	4·79	5·31	5·32	5·61	4·94
Oxygen	32	4·15	5·67	9·53	9·69	10·12
Ash	2	4·91	3·77	4·88	4·03	2·65
	100					

Combustion, or that chemical process by which heat is generated from ordinary fuel, consists in the combination of carbon and hydrogen with atmospheric oxygen.

The amount of heat produced by the combustion of any kind of fuel depends, therefore, on the amount of carbon and hydrogen it contains. The amount of heat produced by any particular fuel, or its calorific power, is expressed by comparison with the amount of heat produced by the combustion of carbon, which is taken as unity. Hydrogen gas, when burnt produces an amount of heat three times as great as that produced by the combustion of an equal weight of carbon to carbonic acid. The calorific power of hydrogen is therefore three times as great as that of carbon. The per centage composition of a fuel being known, it is easy to determine its relative calorific power, that of carbon being =1,000. When the combustible portion of the fuel consists of carbon only, as in coke or charcoal, the per centage of carbon expresses the calorific power or relative fuel value as compared with pure carbon. When the combustible portion of the fuel consists of carbon and hydrogen, the per centage amount of hydrogen multiplied by three and added to the number expressing the per centage of carbon, gives the calorific power of that fuel as compared with carbon; but when the fuel contains oxygen besides carbon and hydrogen, a portion of either or both of these constituents equivalent to the amount of oxygen contained in the fuel must be regarded as already in combustion with oxygen, and, therefore, as ineffective for the production of heat. In such cases it is only the surplus carbon and hydrogen, over and above what are equivalent to the oxygen of the fuel, which can produce heat by combustion. Therefore, the greater the amount of oxygen in any fuel, the smaller will be the calorific power. In this respect there is a great difference between coal and peat. The presence of a large amount of oxygen in fuel affects the calorific power in two ways—viz., by reducing the percentage amount of carbon and hydrogen, and by rendering a portion of those constituents ineffective for the production of heat. For this reason the calorific power of absolutely dry peat is only 660, while that of coal is from 966 to 903.

Hence it will be evident that the maximum capability of peat as fuel is necessarily far below that of coal, even when the peat is absolutely dry. But, as I have already pointed out, that degree of dryness cannot be attained except by kiln-drying, and the ordinary air-dried peat of good quality contains one-fourth its weight of water. Here then is a further reduction of the calorific power of this substance, by one-fourth or to 495; about one half that of coal.

In some cases where peat is needed for fuel it is essential to have it quite dry, and then it is worth while to kiln-dry it; but there is no saving effected by so doing. The 25 per cent. of water separated by kiln drying requires for its separation a determinate quantity of heat and a proportionate consumption of fuel, which is equally consumed without useful effect, whether the peat be used as fuel in the air dried state or whether it be kiln dried before it is used.

These simple considerations will be sufficient to show what a palpable delusion it would be to suppose that peat could possibly be in any way equal to coal in fuel value.

The greater bulkiness of peat as compared with coal is another circumstance which operates against its application as fuel. The average of coal has a density corresponding to 80 pounds to the cubic foot, while air-dried peat has a density corresponding to only 64 pounds to the cubic foot. A cubic foot of coal, in the state in which it is used, contains about 60 pounds, whereas peat in the same way weighs only 30 pounds to the cubic foot, so that with only half the calorific power it takes twice the space, and to produce a given effect with air dried peat, it would require twice the weight and four times the bulk of the coal to produce that effect.

Hence has arisen the idea of compressing peat. It is notorious that no success has attended any of the attempts to carry this idea into practice, and that this should be the case is very easily intelligible. Absolutely dry peat of the very best quality has a fuel value of 660 as compared with coal at 960; in order, therefore that equal bulks of coal and peat should have the same fuel value, a cubic foot of peat must contain nearly one and a half times as much in weight as a cubic foot of coal, or nearly 116 pounds to the cubic foot, corresponding to a density of 1,800. Whether such a compression of peat is or is not possible in practice I will not pretend to say, though I consider it very improbable, and even if it were effected so as to be of practical utility, there would still be the disadvantage attending the use of peat as fuel, that its calorific power would be only two-thirds that of coal, and that one and a half times as much must be used to produce the same effect.

As regards the use of peat for fuel, it now remains only to consider what are the circumstances under which it can be used for this purpose, and under which there is an advantage in using it rather than coal. I can best illustrate this by a case within my own experience. During the last four years I have had occasion to manufacture a large quantity of bricks in one of the Western Islands of Scotland, and for that purpose required fuel for raising steam to drive the brick machinery and for burning the bricks. Coal could be delivered at the port of Stornoway at about 18s. per ton, and, as the works were at some distance inland, there was a cartage amounting to 4s. per ton, making the cost of the coal 22s. per ton. But I found that the peat, of which there was abundance close to the works, was capable of raising steam well, and of being used for burning the bricks, and that, taking it to have only half the fuel value of coal, and even with very imperfect arrangements for bringing it in from the moor, I could, for 8s., put down at the boiler or at the kiln, a quantity of peat equivalent to one ton of coal, thus making a difference of 14s. between the use of a ton of coal and the use of peat equivalent to it. As the burning of the bricks required about half a ton of coals per thousand, this was equivalent to a saving of 7s. per thousand in the cost of the bricks. In this case, therefore, there was an unmistakeable advantage in using peat as fuel, and the advantage would have been still greater if there had been a more efficient means of bringing in the peat from the moor. In the case to which I now refer this cost as much as the peat itself cost on the moor, or about 2s. per ton.

In the town of Stornoway, however, it is found to be more advantageous to use coal at the gas works, and as fuel for the steam-boiler at the slip, and for general purposes, since there is no organised system for supplying the peat from the moors, which are three or four miles distant from the town, the consequence being that the gathering and cartage of the peat costs as much as 4s. or 5s. per ton over and above the cost of cutting and drying, or, in all, 6s. or 7s. per ton. At that cost it is evidently better to use coal, which is so much more easily obtained, and which, being double the fuel value of peat, is not much dearer.

From my own experience of the use of peat as fuel, I consider that wherever it can be had on the spot, and, with a fuel value one half that of coal, can be put down at a cost of 4s. per ton at the place where it is to be used, it may be advantageously substituted, when coal, under the same circumstances, costs more than 10s. per ton; but if coal can be had for 10s. per ton, or less than that, there would be a disadvantage in using peat.

When the place where peat is to be used is far distant from the moor where it is cut, the cost of its carriage, under the most favourable circumstances, amounts to twice as much as the carriage of coal, because the fuel value being only half that of coal, two tons of peat are required for one ton of coal. This necessarily limits the use of peat as fuel to places near the moors where it is cut.

Besides the compression of peat, various other modes of improving it for use as fuel have been tried; the general principle of all these modes of treatment is the kneading or pugging of the peat, so as to give it a more uniform and compact texture and greater density. Peat which has been prepared in this way will have, when dried, a density sometimes equal to that of coal; but I have never been able to perceive how these operations can be advantageously applied to peat, for the following reasons:—In the first place it must be remembered that to obtain a ton of dry peat it is necessary in the kneading or pugging which is intended to improve its texture to operate upon five tons of material. Supposing that to be rendered practicable by suitable mechanical contrivances, so as not to cost more than it is worth or more than is proportionate to the consequent improvement of the peat, it must be remembered that this kneading or pugging of the peat does not separate the water—it does not dry the peat. This—which is the greatest difficulty of all in regard to the use of peat—still remains to be done, and even admitting that some of the water may be separated by the pugging there will be at least three tons of water to evaporate in order to obtain one ton of dry peat.

The idea of employing heat to evaporate that water, of drying the peat artificially, is quite out of the question, since the consumption of fuel for that purpose would be quite disproportionate to the value of the peat obtained. The only plan of drying that is practicable is air-drying, and to dry peat by exposure to the air it must be spread out over a large surface. Every ton of dry peat will require 75 square yards of drying ground, and if the quantity of peat required every year is 30,000 tons, the area of the cutting ground will be one square mile at least. Now if the peat is to be submitted to the operation of kneading or pugging, and has then to be dried by exposure to the air, it must, if the pugging machinery is fixed, be carried to the machine and then carried back to the spreading ground. This carriage to and fro will amount to ten times as much as the carriage of the dry peat itself, and must evidently add considerably to the cost. If, on the other hand, the pugging machine be locomotive, another obstacle to the adoption of this plan of treatment arises from the necessity of carrying out the cutting and spreading of the peat within a very limited time, as I have already pointed out.

Now, when we consider all these circumstances, and compare the cost of applying this treatment to peat with the results effected by its application, I think it must be obvious to any one acquainted with the peat districts, with the use of machinery, and with the value of fuel, that the attempt to apply such treatment to peat is like breaking a fly upon a wheel, that the means are totally disproportionate to the end, and that the use of peat as fuel is altogether dependent on local circumstances, the principal of those circumstances being the want of coal or the high price of it, and the presence of an abundance of peat of good quality. These are the circumstances which would determine the consumer of fuel in choosing peat or coal. It is entirely a question of cost. To the landowner there may be in some cases other inducements to promote the use of peat in place of coal, such, for instance, as the employment of a population which would otherwise be in idleness; the desire to clear away the peat and make land available for agricultural purposes;—but these circumstances are all incidental, and of a nature foreign to the true merits of the question as to the value of peat as fuel.

I am quite convinced, however, that there are many places in the Highlands of Scotland, and perhaps also in Ireland, where the concurrent influence of a variety of circumstances favourable to the application of peat as fuel, is sufficiently great to admit of a vast amount of good being effected by carrying out the cutting of it on a large scale. Thus, for instance, steam communication between Glasgow and the various ports of the Western Islands of Scotland is still very expensive on account of the necessity of sending out the coal for the return passage of the steamers. The cost of the coal consumed in the steamers running between Glasgow and Stornoway is about £80 each passage, and there is much more than a mere probability that a judicious and liberal minded application of capital would be succcessful in establishing the use of peat as fuel in those steamers on their return passage to Glasgow. The applicability of the peat for this purpose is undubitable. I have employed peat as the only fuel for steam boilers during the last four years, and have found it to answer admirably. It has also been tried by Mr. James Napier, of Glasgow, on board his steamer the *Lancefield*, and he is of opinion that it might be used in the place of coal. The fact of its being only half the fuel value of coal would in this instance be counterbalanced by the advantage of its cost being less than that of coal. Besides this, the steamers running between Glasgow and the Western Islands are chiefly supported by the freights from Glasgow; their return cargoes are sufficiently small to admit of their using peat as fuel, although a greater weight and bulk would be needed of it than of coal. Moreover, the peat being a natural production and incumbrance of those islands, its use for this purpose would at once be a means of establishing a productive industry and also of affording what is so much needed there,—a greater opportunity for employment—while at the same time the condition of the people would be bettered; and, by the removal of the peat, land would be cleared for cultivation, and the climate improved and rendered less unfavourable to vegetation. At present, however, the peat deposits of these islands and of the Highlands generally, though containing the elements of social amelioration, of industry, and of wealth, lie like a huge inanimate chaos, burying the land which might yield abundant harvests, preventing the labour of the inhabitants, and hindering the development and maturing of the crops on those few patches of ground which are yet cultivated.

The next application of peat, and that to which I purpose to refer more especially in this paper, is the manufacture of oils and paraffin from it by distillation.

It will doubtless be remembered that, in the year 1849, great interest was excited in Parliament and throughout the country by the announcement that a method of obtaining valuable products from the peat of the Irish bogs had been discovered, and that a company had been formed for the purpose of carrying out, on a large scale, the manufacture of those products from peat in Ireland.

The proposed undertaking was very warmly supported by the press, and was described in a popular journal as constituting an Irish El Dorado.

This mode of working peat was devised by Mr. Rees Reece. It consisted in distilling the peat in a kiln, much in the same way as Lord Dundonald, in 1781, distilled coal for tar, oil, etc., with this difference, that Mr. Reece employed a kiln constructed more in the form of an iron smelting furnace at the bottom, and that he employed, as in such iron furnaces, a blast of air for the purpose of maintaining the combustion of the peat at the lower end of the kiln, by which means heat was produced for distilling the peat at the upper part of the kiln. By thus distilling peat, a tar was obtained which, on subsequent distillation and treatment, yielded oil and paraffin.

In consequence of the very great public attention directed to this project, an investigation of the subject was instituted, at the suggestion of Lord Clarendon and the Chief Commissioner of Woods, by the chemical officers of the Museum of Irish Industry, under the direction of Sir R. Kane. The results of that inquiry were published in a Blue-book in the year 1851.

Among the products which were shown to be obtainable from peat, were paraffin and certain hydro-carbon oils, which it was proposed by Mr. Reece to use as solvents of india rubber and for lubricating machinery.

These oils and paraffin were obtained, in the first instance, as tar, by the distillation of the peat, and the results given in Sir R. Kane's report go to show that there is no serious difference in the nature and amount of the produce, whether the distillation of the peat be conducted in close retorts or in kilns, as proposed by Mr. Reece.

The experiments that were made with different kinds of peat gave the quantitive results shewn in Table I. (next page).

There is some degree of discordance in these results, but, taking the average, it will be seen that the peat distilled in close retorts yielded nearly 3 per cent. of tar, and when distilled in kilns it gave nearly 2½ per cent. In the former case the tar gave, on the average, rather more than half its weight; and, in the latter case, rather less than half its weight of refined oils and paraffin.

It must be borne in mind that all the varieties of peat referred to in Sir R. Kane's report are true "bog peat," the only result quoted by Sir R. Kane for mountain peat being that obtained by Dr. Hodges, of Belfast, in 1850, from an experiment conducted by him with about 50 tons of peat at Newtown Commelin, in Antrim.

Taking the average of these results, the 100 tons of Irish bog peat would yield by distillation in close retorts 2 tons. 15 cwt. of tar, which gave by subsequent treatment 409 gallons of refined oils and paraffin, and by kiln distillation the 100 tons would yield 2 tons 8 cwt. of tar, or 304 gallons of refined oils and paraffin.

If this tar, or the oils and paraffin it yields, be taken as the sole commercially valuable products from the distillation of the peat, and if the cost of the peat is taken as 2s. per ton, as set down by Mr. Reece, and quoted in Sir R. Kane's report, the tar would cost, for raw material alone, about £4 per ton, and the cost of raw material equivalent to one gallon of refined oils and paraffin would be 7d.

Adding to this cost of raw material the cost of making the tar and refining the oil and paraffin as amounting jointly to 1s. per gallon, the total cost of the refined product would be 1s. 7d. per gallon.

Table I.

KIND OF PEAT.	Pounds per cubic foot.	Peat distilled in retorts.			Peat distilled in kiln.			
		Per centage of tar.	Per centage of oil from tar by weight.	Refined oil from 1 ton tar, gallons.	Per centage of tar.	Per centage of oil from tar by weight.	Refined oil from 1 ton tar, gallons.	
1. Mixed light and dense turf (Phillipstown)............	33·5	2·000	58·6	155	—	—	—	Sir Robert Kane and Mr. Sullivan.
2. Light surface turf (Allen)......	21·0	3·577	46·1	121	2·510	55·3	144	
3. Dense peat (Allen)............	29·7	2·767	43·8	115	2·395	43·1	113	
4. Light fibrous turf (Ticknevin).	30·3	2·916	70·2	184	—	—	—	
5. Light fibrous turf	,,	2·344	64·2	168	—	—	—	
6. Light fibrous turf (Shannon)...	17·5	4·417	38·2	100	2·270	50·0	132	
7. Dense Peat (Shannon)	53·3	1·462	70·1	184	2·391	48·5	128	
Average	—	2·787	55·9	147				
8. Dense mountain peat (Antrim)	—	—	—	—	4·440	—	—	Dr. Hodges.

It is not very probable that at this rate of cost the manufacture of these products from peat would be very remunerative, especially at the present market price of these oils and paraffin; but in Sir R. Kane's report, which has especial reference to Mr. Reece's project for working peat, other products besides the oil and paraffin are taken into account as adding to the profits that might be expected from this undertaking.

These products are sulphate of ammonia, acetate of lime, and wood naphtha; and so much were they regarded as a source of profit to be anticipated from the working of peat, that in the prospectus of the Irish Peat Company they were set down as furnishing more than one-half of the expected profits of the works.

The values assigned to these products in Sir R. Kane's report are not inded quite so great, as regards the amount as those stated by Mr. Reece, but they are, nevertheless, considerable, being for the 100 tons of peat as follows :—

Mr. Reece.

	£	s.
Sulphate of ammonia, 20 cwt. at 12s.	£12	0
Acetate of lime, 14 cwt. at 14s.	9	16
Wood naphtha, 52 gals. at 5s.	13	0
	£34	16

Sir R. Kane and Mr. Sullivan.

	£	s.
Sulphate of ammonia, 20 cwt. at 12s.	£12	0
Acetate of lime, 4 cwt. at 14s.	2	16
Wood naphtha, 52 gals. at 5s.	13	0
	£27	16

These results have a very attractive appearance, even in both cases; but a closer examination of the subject of peat working from a commercial point of view, led me to the conclusion that it is a fallacy to regard these products as constituting a source of profit to be obtained in working peat. On the contrary, I consider that no reliance should be placed on the value of these products as contributing in any way towards the possibility of peat being worked advantageously. They should be regarded strictly as waste or bye products, and the question whether peat can be worked remuneratively must be determined by regarding the oils and paraffin alone as the staple products. If these can be obtained in such proportion, and at such a cost as to afford a profit on the manufacture, it may then become a question to consider whether the bye products obtained in that manufature are not worth working up for the sake of the ammoniacal salts and other materials they would yield. This question would be determined one way or another by a variety of circumstances of more or less special nature. Among others, the possibility of making some portion of the waste of the chemicals employed in the purification of the oils and paraffin, available for working up these bye products, would be of prominent importance, inasmuch as that would, to some extent, reduce the cost of purifying the oils, &c.

I shall have occasion afterwards to point out results corroborative of this view as to the really valuable products of peat.

Keeping this principle in view, meanwhile, I will now request your attention to the production of paraffin and oil from peat. In the early part of 1858, I was consulted as to the possibility of working the tar obtained from the peat of the Island of Lews, one of the Hebrides. The peat occurring in this island is, as I have before mentioned, a true mountain peat, and, like most of the peat in the Highlands of Scotland and north of Ireland, is a remarkably rich bituminous variety. It is of a dark brown or black colour, and heavier than water, weighing sometimes as much as 78lbs. the cubic foot. It burns with a brilliant white flame, of great length, and considerable heating power, indicating the presence of a large amount of bituminous substance.

The tar obtained from this peat by distillation was quite solid at the ordinary temperature; it was of a dark brown colour, with a penetrating odour of creosote, and melted on the fingers like butter in consequence of the paraffin it contained. Its density was 0·960.

The analysis of this tar showed that it yielded hydrocarbon oil and paraffin of good quality. Two samples, one made in a close retort, the other in a kiln, gave the following results by weight:—

	Retort.	Kiln.
Refined Oil and Paraffin............	42·161	41·167
Creosote	30·459	47·068
Charcoal gas and waste............	27·380	11·765
	100·000	100,000

These quantities correspond respectively with 112 and 107 gallons of refined oil and paraffin from the ton of tar.

About a ton of the tar was then operated upon for the purpose of getting the products in such quantity as would admit of their being tested as to their applicability for various purposes.

The oil obtained from the tar was purified by the ordinary methods of treatment applicable to such materials, and was then separated by distillation into two portions; one portion of the oil, amounting to about one half of the gross refined product, was quite liquid even at low temperatures; it was of a pale yellow colour, with a slight and not unpleasant smell. It burnt well in the lamps commonly used for hydro-carbon oils, with a brilliant white flame. It did not carbonize the wick, while burning, or resinify by exposure to the air. Its boiling point being above 300° F, there was no danger of its giving off explosive vapour at any temperature it would be likely to be heated to when used in a lamp, and, as compared with some other oils of good quality, it gave, measure for measure, a greater quantity of light.

The other half of the oil was partly solid at the ordinary temperature; it consisted of an oil of greater density than the one I have just mentioned, and of higher boiling point, mixed with a great quantity of paraffin partly in solution and partly crystallized. This paraffin was easily removed by a filtering bag and the dissolved portion was separated, by cooling the oil and then filtering it again. The paraffin thus obtained amounted to about one tenth part of the gross refined product. The oil from which the paraffin had been separated was, like the other oil, of a pale yellow colour, and had scarcely any smell. It burnt with an intense white luminous flame, and when mixed with fat oils formed an excellent lubricator.

The proportion of refined oil and paraffin which I obtained from the ton of tar was about 112 gallons in all; in round numbers it might be said that on a working scale the tar on which I operated would give 100 gallons refined oils and paraffin per ton. This was very much less than the average amount of the products obtained by Mr. Sullivan from the Irish peat, as stated in Sir Robert Kane's report; but, on the other hand, the amount of tar obtained from the Irish peat was very small, and I expected, from the difference between the peat operated upon by Mr. Sullivan and that of Lews, that this latter, being of a much more bituminous character, would yield by distillation a larger amount of tar.

With regard to the possibility of carrying on the manufacture of these products on a large scale, everything depended upon the cost at which the tar could be produced. Judging from the results that had already been obtained, it appeared to me that £5 per ton was the maximum price that could be allowed for the tar, supposing it to yield 100 gallons of refined oils and paraffin, and that with this cost for the tar, it would be possible to work it profitably if the purification of the oils did not cost more than sixpence per gallon.

These limits having been fixed as to the cost of tar and refining the oils, it became requisite to ascertain the cost of the peat, the amount of tar it yielded, and the cost of production. At that time the cost of the peat on the moor was 2s. 6d. per ton for cutting, drying, and stacking, by contract, but there were satisfactory reasons for expecting that it could be obtained at a less expense. These expectations were subsequently realised, peat having been obtained by contract in succeeding years at 2s., 1s. 9d., and 1s. 6d. per ton; and some which I had cut under my own direction did not cost more than 1s. per ton stacked on the moor. I now think that from 1s. to 1s. 6d. per ton might be fairly taken as the prime cost of air-dried peat containing 20 to 30 per cent. of water.

The amount of tar obtainable from the peat is of considerable importance. The amount obtained by Mr. Sullivan from Irish peat, in no instance amounting to 5 per cent., and on the average 2·5 per cent, is far too small to admit of the peat being worked profitably.

The influence of an increased yield of tar on the cost of the products, will be very clearly apparent from Table II. (next column), in which the quantity of peat worked per week is throughout taken as 100 tons, and the yield of tar varying from 1 to 10 per cent.

It will be seen that a yield of 3 per cent. tar from the peat would, at the cost of peat and labour assumed in this table, make the cost of the tar £6 6s. 8d. per ton, and that if the refined product from the ton of tar amounted to only 100 gallons, the cost of the oil would be 1s. 10d. per gallon, or far too much to admit of profitable working.

To determine this point, therefore, with certainty, an experimental distillation of the Lews peat—air dried—was made in a close retort; it gave the following results:—

Tar .... 9·855
Charcoal { Carbon .... 30·25 / Ash .... 1·25 } .... 31·500
Water .... 37·875
Gas .... 21·540
100·000

which were subsequently confirmed by trials on a larger scale.

TABLE II.

Per centage yield of tar from peat.	Quantity of peat worked per week. Tons.	Tar produced.		Refined oil and paraffin. Gallons.	Cost of tar made.			Cost of tar per ton.	Cost of tar equivalent to 1 gall. refined products; these being 100 gals. = 1 ton tar.	Cost of refining per gallon.	Cost of refined oil per gallon.
		Tons.	Gallons.		Peat. 2s. per ton.	Labour.					
					£	£	£	£ s. d.	s. d.	s. d.	s. d.
1	100	1	233	107	10+	10=	20	20 0 0	4 0	0 6	4 6
2	100	2	460	214	,,	,,	,,	10 0 0	2 0	,,	2 6
3	,,	3	699	321	,,	,,	,,	6 6 8	1 4	,,	1 10
4	,,	4	932	428	,,	,,	,,	5 0 0	1 0	,,	1 6
5	,,	5	1165	535	,,	,,	,,	4 0 0	0 10	,,	1 4
6	,,	6	1398	642	,,	,,	,,	3 6 8	0 8	,,	1 2
7	,,	7	1631	749	,,	,,	,,	2 17 2	0 7	,,	1 1
8	,,	8	1864	856	,,	,,	,,	2 10 0	0 6	,,	1 0
9	,,	9	2097	963	,,	,,	,,	2 4 6	0 5½	,,	0 11½
10	,,	10	2336	1070	,,	,,	,,	2 0 0	0 5	,,	0 11

The tar thus obtained, as I have already mentioned, yielded 42 per cent. by weight of refined oil and paraffin; so that the 100 tons of peat, as compared with the average of Irish peat, would yield:—

	Tons.		Tar. galls.		Crude Oil. galls.		Refined Oil. galls.		Creosote. galls.
Lews peat	100	...	2,097	=	1,629	=	999	+	630
Irish peat	100	...	478	=	686	=	357	+	343

In this case, taking the cost of the peat as before, at 2s. per ton, the quantity of Lews peat, equivalent to one gallon of refined products, would cost only 2½d. instead of 7d., as in the case of the Irish peat; and adding in each case 1s. per gallon as the cost of manufacture, the refined oil from Lews peat would cost 1s. 2½d. per gallon, while that from Irish peat would cost 1s. 7d. per gallon.

In the above table the cost of manufacture is taken from the results of actual experience; but the per centage of tar, which I have just referred to as obtainable from the Lews peat, was obtained by distilling it in a close retort. This is not the plan that has been adopted practically, and it is possible that in distilling peat with close retorts, the cost of manufacture would be increased beyond what has been quoted in the above table, by the necessity of using some peat for fuel; if, for instance, it should be found that the charcoal obtained from one operation was insufficient for the distillation of a subsequent charge of peat. If that were the case, the working with close retorts would involve an additional expense for fuel. The peat thus consumed as fuel would, in reality reduce the actual per centage of tar obtained from the peat consumed, and if one-third the weight of the peat were consumed as fuel, the per centage of tar obtained would be, in fact, not 9·8 per cent., but only something like 6 per cent.

At the outset of the inquiry into the working of the Lews peat, it therefore became an important question whether it would not be more economical to work with kilns, as was done at the Irish works; whether the large yield of tar obtained with retorts was not to some extent only apparent; and whether a smaller yield of tar, obtained by means of kilns, might be more advantageous by reason of their smaller original cost, and of their requiring a smaller expense for labour and fuel in working than retorts.

The small amount of tar obtained from the peat at the Irish works was, no doubt, partly a consequence of the inferior character of the peat; but a little consideration of the circumstances under which the peat was distilled will suffice to show that it was mainly attributable to the use of the blast employed for maintaining the combustion, in the same manner that it is employed in an iron-smelting furnace. Some results are indeed mentioned by Mr. Reece, and quoted by Sir Robert Kane in his report, which clearly suggest this view. Thus, for instance, Mr. Reece states that, in the experiments made in Antrim in 1850, with a kiln 3 feet diameter and 15 feet deep,—

When the quantity of peat distilled during 24 hours was 1½ ton, the produce of tar was 70lbs. per ton = 3·1 per cent.

When the quantity of peat distilled during 24 hours was 2 tons, the produce of tar was 40lbs. per ton = 1·8 per cent.

When the quantity of peat distilled during 24 hours was 3 tons, the produce of tar was 22lbs. per ton = 0·98 per cent.

When the quantity of peat distilled during 24 hours was 9 tons, the produce of tar was only 2lbs. per ton.

In the experiment by Dr. Hodges, which gave 4·44 per cent. of tar, the distillation of two tons of peat occupied three days, and the blowing machine employed in that experiment is described as having been "very inefficient," and furnishing only "an intermittent blast of no great power." The same fact is pointed out in Sir Robert Kane's report, as having been observed in the course of the investigation made at the Museum of Irish Industry by Mr. Sullivan. When much air was blown through the apparatus, scarcely any condensible products were obtained; when little air was blown through, the distillation was very slow and incomplete.

This result of a very small yield of tar when a strong blast was used appears to be clearly attributable to the peat having been burnt in the kiln instead of having been distilled; and this view of the matter led me to the conclusion that it would be advantageous to dispense with the blast altogether, as being not only very expensive, but also useless and unsuitable for the production of tar. It appeared to me that a more appropriate means of maintaining the combustion of the charcoal at the lower part of the kiln, so as to produce the requisite heat for distilling the peat at the upper part, would be to have a fire-grate at the bottom of the kiln, and to establish a draught through the fire by exhaustion from the upper end of the kiln. It appeared to me, moreover, that by this means the escape of the tar vapour from the kilns would be facilitated in a much greater degree than by the blast driven into the kilns at the bottom.

This opinion was supported by the result of some experiments made with a small kiln, constructed in this manner, which was worked for some time in Lews. In this kiln the draught was produced by means of a chimney placed at the further end of the condenser, and the yield of tar obtained with this experimental kiln amounted to 5 per cent.

The tar thus produced differed somewhat from that obtained by distillation in close retorts chiefly in respect to the relative proportions of light and heavy oils and paraffin, as will be seen by the following results of the analyses of these two tars:—

	Density.	Retort Tar.	Kiln Tar.
Light oil	(0.820—0·830	18·678	5·147
Heavy oil	0·870	20·165	30·885
Paraffin		3·318	5·135
Creosote		30·459	47·068
Charcoal gas and waste		27·380	11·765
		100·000	100·000

This difference might, however, be owing to defective condensation of the more volatile portions of the tar vapour, as the arrangements connected with the experimental kiln were in many respects very imperfect. Otherwise the tar was as easily worked as that obtained with close retorts and the general result of the trials made with this kiln was so far favourable to this mode of working, that when arrangements were made for erecting works to make six tons of tar a week, it was determined to construct a range of kilns of this description, in preference to putting up retorts; at the same time it was hoped that with a more efficient arrangement for condensing the tar vapour, a larger yield of tar than 5 per cent. might be obtained.

These preliminary matters having been satisfactorily disposed of, preparations for erecting works were commenced in the early part of 1859. The tar kilns were cylindrical brick chambers 5ft. diameter and 12ft. high, with a fire-grate of about 2ft. area at the lower end, and a hopper with a lid at the top for introducing the peat. Ten of these kilns were constructed side by side in a block of brickwork. From the side of each kiln passed a pipe 12in. diameter, which was connected with a main 3ft. diameter, extending round the whole range of kilns, and into which the tar vapour from the kilns was discharged. From this main the vapour passed into a series of pipes 12in. diameter, arranged on cisterns much in the same manner as the condensers of gasworks, but with the difference that there was no water joint. After passing through this condenser the uncondensed gases were discharged into a brick chamber with numerous partition walls, and thence into a large flue running for about fifty yards up the side of a hill on the top of which was placed a chimney 30ft. high.

A tramroad ran along the top of the kilns, communicating with the tramroads diverging through the moor, for bringing up the supplies of peat; and, as the peat burnt away at the fire-grates, a fresh quantity was introduced at the upper ends of the kilns. This charging required to be repeated every two or three hours. The product collecting in the condenser cisterns was a thick creamy mixture of tar and water of a pale sulphur colour, from which the tar was separated by heating it in a large boiler and skimming the tar off the surface.

With this arrangement work was commenced about the end of August, 1860; but, owing to the wet state of the brickwork, and to a temporary difficulty with the workpeople, it was not until the early part of October that the kilns were got into regular working order. From that time the work was carried on without any considerable interruption until the end of February, 1861. The results obtained during this period were far from being satisfactory. In the first place, the tar made did not amount to more than 3 per cent. of the peat consumed; and, in the second place, the quantity of peat worked did not amount to more than 50 tons a week on the average.

The expenses of labour in working the kilns being very nearly the same, whether the quantity of peat worked was large or small, the slow rate of working necessarily increased the cost of the products, and this circumstance has an influence as important in this respect as the yield of tar, as will be apparent from the comparison given in the table on the next page.

Moreover, the rate of working was subject to wide variation. This latter circumstance, which was productive of much inconvenience, appeared to be mainly determined by the state of the wind. During calm weather the quantity of peat worked was not much more than half that worked when there was a fresh breeze. With a dead calm the action of the kilns would sometimes be entirely stopped, and during gales, which were of very frequent occurrence, it was impossible to continue working. The most troublesome effect of these two extreme conditions was the production of a back draught from the chimney, through the condenser, towards the kilns, by means of which air became mixed with the vapours and combustible gases; and, when this admixture reached a certain limit, explosions sometimes took place, which were both inconvenient and dangerous.

The slow rate of working which, as shown by the following table, rendered the charge for labour proportionately much greater, was, to a great extent, a consequence of the feeble and irregular draught produced by the chimney. In addition to this, the tar vapour did not appear to escape from the

Per centage yield of tar from peat.	Quantity of peat worked per week.	Tar produced.		Refined oils and Paraffin.	Peat, 2s. per ton.	Labour.		Cost of tar per ton.	Cost of tar equivalent to 1 gallon of refined oil.	Cost of refining per gallon.	Cost of refined oil per gallon.
	tons.	tons.	galls.	galls.	£	£	£	£ s. d.	s. d.	d.	s. d.
5	50	2½	583	268	5 +	10 =	15	6 0 0	1 2½	6	1 8½
,,	120	6	1398	642	12 +	10 =	22	3 13 6	0 9	,,	1 3
,,	200	10	2330	1070	20 +	10 =	30	3 0 0	0 7¼	,,	1 1¼

kilns through the 12in. discharge pipes with sufficient ease. The consequence was that much tar was condensed among the cold peat at the top of the kiln, and this tar, melting afterwards, ran down to the fire, and was there more or less burnt and destroyed. Hence the small yield of tar.

Since the feeble draught of the chimney was the chief cause of these unsatisfactory results, and since that was itself a consequence of the extreme refrigeration of the vapour and gas during its passage through the condenser, the defective draught might have been remedied by maintaining a fire at the base of the chimney, so as to heat the cold, uncondensed gas escaping from the condenser, where the tar had been deposited, sufficiently to produce a steady draught; but, since the gas escaping into the chimney was highly combustible, this would have been too hazardous a plan to adopt, inasmuch as the weather was frequently so boisterous that it was with difficulty that work could be carried on at all out of doors; and, as the kilns were worked continuously, there would have been much inconvenience attending this mode of working during the very long nights of winter.

Under these circumstances, it appeared to me desirable to have recourse to some mechanical means of producing a draught, that would be constant in its action, easily under control, and which would admit of the gases discharged from the condenser being burnt with safety by the introduction of a water joint between the condenser and the place where they were burnt. A further reason for adopting an arrangement of this kind was the presence, in the uncondensible gases escaping from the condenser, of a large quantity of tar, which was suspended in a kind of vesicular position, and was not separable by any amount of cooling that was practically applicable. The smell produced by the escape of this tarry gas into the air was exceedingly offensive for miles round, and for this reason, as well as for the sake of using the gas as fuel, it was determined to burn it. Moreover, though the separation of this suspended tar could not be effected by cooling the gas, it was easily separated by mechanical means, such as passing the gas over loose bunches of heather. This plan has been adopted while working with the chimney draught, and, so far as the separation of the tar was concerned, it succeeded perfectly. A long brick chamber was connected with the flue leading to the chimney, so that the gases were made to pass along it in a zigzag course by coming in contact with bunches of heather tied to cords and suspended from the roof of the chamber. The effect of this arrangement in separating the suspended tar was instantly recognisable, the gases escaping from the chimney being almost free from tar. But the draught of the chimney gradually decreased, and at the end of two or three weeks had ceased altogether. On opening the chamber it was found to be entirely choked with tar that had been deposited upon the bunches of heather like drifts of snow. This circumstance suggested the introduction of several such chambers into the condenser, and it was also expected that the passage of the vapour and uncondensible gas through water would have a similar influence in separating this tar. But to overcome the resistance that would thus be offered to the passage of the vapour and gas from the kilns, it was necessary to have a very powerful draught, and, after considering the various means employed at gasworks for exhausting, I decided upon trying the effect of a revolving fan. A very excellent form of fan of great power was suggested for this purpose by Dr. Rankine, but, as time was a considerable object, one of the ready-made fans manufactured, under Schiele's patent, by the North Moor Foundry Company, was chosen for the trial.

In order to get a satisfactory result in working the kilns it was necessary to work up at least seventy tons of peat a week, and to obtain fully 5 per cent. of tar. Assuming that by the application of a fan this result was obtained, then the quantity of uncondensible gas passing away from the kilns might be taken as consisting essentially of the carbonic oxide produced by the combustion of the coke or charcoal yielded by that quantity of peat, plus the oxygen of the air required for its combustion. Taking the peat to yield 25 per cent. of charcoal, and the quantity worked as ten tons daily, there would be some 4lb. of carbon to be converted into carbonic oxide per minute in the kilns. This quantity would require rather more than 300 cubic feet of air, which, by conversion into carbonic oxide, would become about 360 cubic feet, and, at the temperature it entered the fan, might amount to 500 cubic feet. This, then, fixed the minimum capability of the fan to passing 500 cubic feet of gas per minute, even if the quantity of peat worked did not exceed seventy tons a week. But this rate of working was considered too small, and I was desirous of increasing it to double or three times as much, and with that object decided upon employing a fan capable of passing 2,000 cubic feet of gas per minute, so as to leave an ample margin for increasing the rate of working, and to allow for any augmentation of the volume of gas not calculated for.

The fan chosen for this purpose was a 30 in. Schiele's fan, driven at a rate of 1,600 revolutions by an 8 in. engine, which worked some pumps and a winding drum, by which the peat trucks were drawn up an incline to the kilns. This fan was found to produce a powerful steady draught through 7 in. of water, without raising the combustion at the fire-grate of the kilns to a higher degree than was desirable. The area of the discharge pipes from the kilns having been doubled, the vapour was rapidly drawn from the kilns, and the tar was much more completely separated by passing the vapour several times through water and through four chambers filled with layers of heather. The mechanical action of the fan was also found to be very efficacious in separating the suspended tar, which appeared to be churned out of the gas by the fan.

The current of gas discharged from the fan was highly combustible, and burnt freely at the ordinary temperature. In order to prevent its causing an unpleasant smell, and to render it available as a source of heat for generating steam, distilling tar, evaporating liquors, or drying, it was led through an underground tunnel to a furnace, where it burnt with a flame from 6 ft. to 10 ft. high, 6 ft. long, and 6 in. thick.

In working with the chimney draught it had become apparent that the quantity of charcoal produced from the peat, as it passed from the top of the kiln to the fire-grate, was very much greater than was requisite for distilling off the tar from the subsequent charge of peat, and consequently there was considerable waste of time, besides other obvious disadvantages, involved in the combustion of this surplus fuel. To remove this obstacle to the increase of the quantity of peat worked in the kilns, an arched opening was made in each kiln, just above the fire-grate, and fitted with a door, through which the charred peat could be drawn out at intervals, in such quantity as to leave only just enough to serve as fuel for distilling the peat. This plan could not be regularly carried out during the last winter, on account of the danger of opening the doors of the kilns during high winds while the front of the kilns was unprotected by sheds. It was nevertheless found that by drawing out the surplus charcoal the quantity of peat worked was very much increased, and a very much more considerable advantage would have been gained in this respect if the removal of the charcoal could have been effected independently of the weather.

In illustration of the effect of these improved arrangements it may be mentioned that the quantity of peat worked was considerably greater that when working with the chimney draught, being in all cases upwards of 70 tons a week, and while the weather was favourable for drawing the surplus charcoal, upwards of 100 tons a week. The yield of tar was also increased to the extent of 7·5 per cent. of the peat worked, and was on the average as much as 7 per cent. The number of men required for working the kilns was also much smaller than was the case while working with the chimney draught. These results were in every respect very much more favourable than what had been anticipated at the outset, inasmuch as the cost of the tar, instead of being £5 per ton, was under £3 per ton, while on the other hand the quantity made per week, instead of being only 6 tons, was upwards of 7 tons, and was also in a fair way of being increased.

One of the products obtained from the peat tar was a burning oil of excellent quality, similar to paraffin oil and the oil obtained from American petroleum. It was sold last winter in Glasgow, under the name of lignole, and was examined by Dr. Anderson, who expressed his opinion that it would compare favourably with the best varieties of mineral oils obtained from coal. The production of this oil is an important feature of novelty in the working of peat.

The heavier oil obtained from the tar would burn very well, but it requires a different form of lamp from that generally employed now for the hydro-carbon or so-called paraffin oils. When mixed with fat oils it forms a good lubricator. Some samples of this oil, mixed in proportions suitable for the spindles of cotton machinery, were examined by Dr. Rankine, of Glasgow, who reported on them as follows. The standard of comparison was sperm oil:—

"The following table shows the results, the oils being arranged in the order of their friction-reducing powers, as shown by the number of revolutions made by the spindle:—

	Relative lubricating power.	Number of Revolutions.
Oil No. 5	101	416
Sperm oil	100	411⅔
Oil No. 3	98	404
,, No. 2	97	401½
,, No. 1	85	349½

"The conclusions are that the oil No. 5 is somewhat superior to sperm oil as a lubricant, and Nos. 3, 2, and 1, somewhat inferior; but in the case of Nos. 3 and 2 the inferiority is only slight."

"I have not yet had an opportunity of testing by direct experiment the lubricating effects of these oils, or of compounds containing them, on the bearings of large and heavy machinery. The principal difference required in unguents for different kinds of machinery depends on the intensity of the pressure at the bearings; the more intense pressures requiring thicker or more viscid unguents, that they may resist the tendency of the pressure to force them out. Additional thickness is given to an unguent, when required, by dissolving a sufficient quantity of solid greasy matter in the oil; and from previous observation of the properties of unguents containing oils analagous in their chemical character to those with which I have been furnished from the Lews Chemical Works, I am satisfied that the latter oils may easily be thickened in the same manner, so as to adapt them to any intensity of pressure at the bearings to which they may be applied."

The apparatus by means of which these oils was tested, as regards their application to cotton machinery, consisted of a cotton spindle, supported in a vertical position upon a pivot lubricated with the oil to be tested, and carrying a fly or revolving disc. This spindle is set in motion by a constant weight, descending through a constant height, and allowed to revolve freely until it stops of itself, the whole number of revolutions made before stopping being counted by the aid of suitable mechanism. The greater that number of revolutions, the more perfect is the lubrication produced by the oil; and, inasmuch as the bearing at which the friction is tested, is that of an actual cotton spindle, the results of the experiments give a peculiarly satisfactory test of the qualities of the oils for lubricating these bearings, and bearings of light machinery in general.

Having already referred to the Irish Peat Company's works, and to the results obtained there, I would now wish briefly to point what appears to have been the circumstances which contributed to the signal failure of that undertaking. Table III. (next page) contains a comparative statement of the results anticipated from the working of Irish peat, and of the results actually obtained.

Together with these results are given, also, comparatively, the results obtained at the Lews works by myself.

The prices set down for peat, and for the products obtained from it, are the same in the different cases, except in the statement of the working results of the Irish works in 1855. In that case the cost of the peat is set down as 4s. per ton, as reported in one of the official documents of the Company to have been the cost. The value assigned to the oil, in this case also, is not 5s. per gallon, as given in the Company's report, but 2s. per gallon, which I belive to be nearer its true value, and which admits of the results being compared with the other cases, in which that is the value set upon the oil.

The difference between the anticipated and the actual value of the ammoniacal salts, acetate, and naptha, produced from the peat, is strikingly great, and I think it affords sufficient confirmation of the opinion I have already expressed as to the impropriety of regarding these products as constituting any source of profit in working peat, except when the manufacture of the other products is in itself remunerative.

But if these products are disregarded, the amount of oils and paraffin yielded by the Irish peat is so small, as compared with the cost of production, as to leave no possibility of profit. In addition to this, it may be mentioned that the quality of the oil produced at the Irish works was very inferior, and bore no comparison to that of the oil produced at the Lews works. The manufacture of burning oil, indeed, was not attempted at the Irish works in consequence of the offensive smell which the lighter portion of the oil possessed.

On the other hand, the yield of oils and paraffin from Lews peat is from three to four times as great as that obtained from the Irish peat, while the cost of working is but very slightly greater. The cost of peat in the two cases is also very different, for while in Lews, the peat never cost more than 2s. 6d. per ton, and has since been obtained at a much lower rate, the cost of peat at the Irish works was 4s., and even as much as 6s. and 7s. per ton, a circumstance which in itself would be inconsistent with the possibility of working even such peat as that of Lews.

With these facts so clearly apparent, it is not a matter for surprise that the results obtained at the Irish works were not sufficient to afford a return for the enormous expenditure of capital on the works that were established; and to those who take an interest in the subject of peat working it must be a source of regret that the attempt to work the Irish peat was made and followed up with such rash precipitation, and with so little preliminary examination of the capabilities of the material for working which such a large investment was made.

TABLE III.

	1		2		3		4		5		6		7	
	Anticipated results from the working of Irish peat, as set forth in the Company's prospectus, on the authority of Mr. Reece, 1851.	Value.	Sir Robert Kane's report, 1851.	Value.	Working results with Irish peat, as given in Mr. Sullivan's report to the Directors of the Irish Peat Company, 1855.	Value.	Retort tar from Lews peat, 1858.	Value.	Kiln tar from Lews peat, 1858.	Value.	Working trial of 1 ton kiln tar from Lews peat, 1858.	Value.	Working result from Lews peat since the fan was used, 1861-62.	Value.
		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.
Quantiy of peat worked ..	100 tons.	10 0 0	100 tons.	10 0 0	100 tons.	20 0 3	100 tons.	10 0 0	100 tons.	10 0 0	100 tons.	10 0 0	100 tons.	10 0 0
Sulphate of ammonia ...	20 cwt.	12 0 0	20 cwt.	12 0 0	3 cwt.	1 16 0								
Acetate of lime	14 cwt.	9 16 0	4 cwt.	2 16 0	—									
Wood naphtha, 5s. per gallon	52 gals.	13 0 0	52 gals.	13 0 0	10 gals.	2 10 0								
Crude oil, 1s. ,, ,,	300 galls.	15 0 0	300 gals.	15 0 0	—									
Paraffin, 1s. per lb.	300 lb.	15 0 0	300 lb.	15 0 0	300 lb.	15 0 0								
Refined oil, 2s. per gallon					150 gals.	15 0 0	} 999 gals.	99 18 0	535 gals.	53 10 0	500 gals.	50 0 0	749 gals.	74 18 0
Creosote							630 gals.		560 ,,					
Total value of products		64 16 0		57 16 0		34 6 0		99 18 0		53 10 0		50 0 0		74 18 0
Cost of material and manufacture		32 2 0		32 2 0		34 3 4		Cost of working not ascertained.		37 10 0		37 10 0		38 14 6
Balance		32 14 0		25 14 0		0 2 8				16 0 0		12 10 0		36 3 6
Value of oils and paraffin		30 0 0		30 0 0		30 0 0				53 10 0		50 0 0		74 18 0
Cost of material and manufacture		32 2 0		32 2 0		34 3 4				37 10 0		37 10 0		38 14 6
Balance		2 2 0		2 2 0		4 3 4				16 0 0		12 10 0		36 3 6

Under any circumstances the working of peat is surrounded by many serious difficulties as regards both its establishment and prosecution. The districts where peat occurs are generally wild and remote, destitute of all those appliances and facilities for industrial operations which are to be met with in more cultivated parts of the country; the climate inhospitable and unfavourable for out-door work, and the inhabitants—accustomed to a rude mode of life, disliking work, and strenuously opposed to anything differing from their customary habits—are not easily trained to systematic labour. But these are not impassable barriers; they are merely obstacles which are to be overcome by patient perseverance, and, from the practical experience I have had of this subject during the last four years, I feel convinced that such peat as that occurring in the Western Islands and in the Highlands of Scotland, may be worked advantageously; and that, if the manufacture of these oils, which have now become such an important article of commerce, be carried out with earnestness and perseverance, it will become a means of greatly improving the condition of those districts in every respect, and a fertile source of profit to those who carry it out.

DISCUSSION.

The **CHAIRMAN** said a great number of interesting facts had been laid before them relative to peat, showing what could be done, and what could not be done, with it. It had been very clearly shown that as fuel it could not compete with coal under ordinary circumstances. One question which occurred to his mind as not uninteresting in connection with the use of peat, was suggested by some recent experiments for making gas from it. It was well known that wood, when treated like coal for gas, yielded it in considerable quantities, which, though at present unavailable for illuminating purposes on account of the large quantities of carbonic acid it contained, might, nevertheless, be rendered fit for use by passing the gas through an alkali, such as lime water, which was capable of absorbing the carbonic acid. Peat was in chemical composition something between wood and coal, and it was not unnatural to imagine that the gas formed by the distillation of it might, by similar treatment, be rendered available for illuminating purposes. Mr. Paul, in the course of his experiments with this material, had probably seen whether much carbonic acid was given off by the distillation of it, and he should be glad to hear that gentleman's views relative to its application to the production of gas.

Mr. **PAUL** replied that for some long time past he had manufactured gas from peat, to light the works where these products were obtained, and he found that the bituminous black peat of Scotland gave forth an abundance of gas under ordinary circumstances. It contained, as the chairman stated, a large quantity of carbonic acid, and if this were to be removed, much washing would be required; but the bituminous black peat in Scotland produced gas of good illuminating power which required no purifying at all for ordinary purposes, such as those to which he had applied it. He had made no reference in his paper to the applicability of peat for gas making, which, he believed, was a matter well worth consideration, because he thought, under present circumstances, the use of peat for gas depended very much upon the peculiar preparation of it of such consistency and character that, when distilled for gas, it would leave behind a coke of commercial value. That had not yet been done, as far as he was aware, but if it could be accomplished at a price which would be commercially remunerative, peat would undoubtedly become an important gas-making material.

Mr. **KEATES** said he had made experiments himself upon the manufacture of gas from peat, and had succeeded in obtaining as much as 10,000 cubic feet per ton, but the per-centage of carbonic acid was very large indeed; in some cases amounting to 22 per cent., which was practically a prohibition of the use of the gas until some cheap means was found of removing that impurity, which greatly reduced its lighting power. It could not be washed out by being passed through lime water. The absorption of 20 per cent. of carbonic acid gas from a gaseous mixture by means of lime, was, in his opinion, impossible in practice. He believed, however, that the constituents of the carbonic acid might, instead of being produced as carbonic acid, be produced in the form of carbonic oxyde, and then the difficulty would be removed as far as carbonic acid was concerned. Those acquainted with gas making, knew that the existence of even a small quantity of carbonic acid in gas for illuminating purposes reduced the lighting power in an extraordinary degree, and to that extent lessened the practical value of the gas. He should like to hear what per-centage of carbonic acid Mr. Paul had found in his experiments. In his own he could state that the amount ranged from 15 to 20 per cent., and the experiments were made upon several cvarieties of peat, more particularly Dutch peat. Another important point for consideration was that no practical means had yet been found of bringing the peat into a condition of leaving behind a valuable coke, which in gas making from coal formed an essential element in a commercial point of view. The coke produced from ordinary dried peat was so deficient in density as to be of little value.

Mr. **BRUNTON** thought he could throw a little light upon this subject, especially upon the point just alluded to. He agreed with the last speaker as to the essential importance of producing a coke as one of the results of making gas from peat. He thought it probable that Mr. Paul was not aware of a process of treating peat which had been under experiment for the last eighteen months; but he begged to introduce to the meeting specimens of peat merely dried and not compressed, which, when subjected to charring in a gas retort, would produce a charcoal of considerable density. Mr. Brunton having handed in specimens of this peat, and the charcoal produced from it, proceeded to remark that he thought these would show that the difficulty with regard to the production of a solid charcoal in the retort had been got over. Trials made with peat prepared in that manner had shown not only that there was a large amount of gas in the peat, but that the gas was of such high illuminating power as to bear advantageous comparison with gas distilled from coal, whilst the difficulty of the carbonic acid gas alluded to by the last speaker was done away with, in a great measure, by a previous partial charring or baking of the peat before it was used for the manufacture of gas. Mr. Brunton produced specimens of the coke from peat, which was used in the manufacture of pig iron, a specimen of the latter being also shown made in a blast furnace, which he said was a satisfactory proof of the density of the charcoal. The meeting, he went on to remark, might be curious to know how that density was produced without mechanical pressure. The specimens he exhibited, he said, were moulded in an ordinary brickmaking machine, without much pressure, and it became equally hard if rolled into a ball by the hand. The price at which that peat could be manufactured on the bog, did not exceed 5s. per ton. Now, while he quite agreed with Mr. Paul as to the comparative valuelessness of air-dried peat, and the uselessness of pressing it, he would call his attention to the fact that trials with this peat upon a sufficient scale—not in a laboratory, but under the boiler of an ordinary steam-engine of 20-horse power—had demonstrated that the peat, as a heating power, did two and one-third times the duty of coal. In other words, while the consumption of coal in the furnace was 12 cwt. per hour, an equal quantity of peat prepared in this way lasted two hours and twenty minutes, producing the same amount of steam per hour, and doing the ordinary work of the engine. The peat that was used on that occasion was of the same description as that which he now exhibited. The experiments were conducted by Mr. Versmann, who, had he been present, would have given the chemical details more satisfactorily than he (Mr. Brunton) could do. Mr. Versmann came to the conclusion that the peat, as prepared by this process, was a most valuable material for gas purposes, and that it would produce from 12,000 to 14,000 cubic feet of gas per ton, of an illuminating power exceeding that of ordinary coal gas, the amount of carbonic acid not exceeding 10 per cent.; and although that was somewhat in excess of the average of coal gas, yet there were advantages in peat which more than counterbalanced the disadvantages arising from the excess of carbonic acid. He merely wished to call their attention to the fact that there was now a mode of preparing peat which would produce the description of fuel which he exhibited, which had produced results as a heating power equal to two and one-third that of coal, and from which iron had been manufactured in Ireland, which had been pronounced equal to Swedish or Russian iron. The specific gravity of this fuel was nearly equal to that of coal, and the specific gravity increased as the material became drier in process of time.

Mr. W. E. **NEWTON** said, this being a subject in which he had taken considerable interest, and having read a paper upon it before the Society two years ago, he might be allowed to offer a few observations. With reference to the paper read this evening, he would say there were many things with which he cordially agreed, and many others from which he entirely dissented. As regarded the calorific power of peat, as used by Mr. Paul, he did not question the correctness of his experiments, but he was very glad to hear—or rather, to have his own impressions confirmed—that peat, if properly prepared and properly used, gave a calorific power equal to, if not greater than, coal; but the use of peat in manufactures was of greater importance than simply as a fuel for heating purposes. The use of peat in metallurgic operations was a more important thing in this country than merely as a substitute for coal as a heating agent, while they had abundance of the latter at the present time. A great many experiments—more particularly on the continent—had been made with peat as a fuel for metallurgic purposes, and Mr. Siemens and others had found that it produced iron of very superior quality. He had seen specimens which came up to the best quality of Swedish iron. Every iron manufacturer knew that if he could get peat to stand the blast—and the process described by Mr. Brunton gave it—then it was infinitely superior to coal for those purposes, for the simple reason tnat it contained no sulphur. They could produce iron with peat from the worst brands which would almost equal the best Swedish or Russian iron, simply owing to the absence of those deteriorating chemical agents which existed in coal. As regarded gas, he could confirm what Mr. Brunton had said that this peat would produce an enormous amount of gas, something astounding in comparison to that which was produced from coal, and the samples of coke he had seen, as the residuum of peat, were equal in density to that from coal, and were all that the iron manufacturer could require. But one of the chief advantages of the process was that they did not require to convert the peat into coke. The hard specimens which had been introduced this evening by Mr. Brunton were found to be everything that could be desired for the manufacture of iron. He had seen specimens of peat charcoal produced by other processes, which were exceedingly good for various purposes, such as for fertilisers of land and disinfectants. In the paper which he read two years ago, a number of results were stated, which, at the time, excited a great deal of attention on the part of those interested in the question. He thought one of the reasons why they had not succeeded in bringing the manufacture of the products of peat into more general use, arose from the fact of people wanting to do too much. If they analysed a sample of peat and brought out a string of a dozen or twenty substances to be obtained from it, and if they attempted to obtain all those substances, it was clear they would fail commercially; but if a man confined himself to taking the peat from the bog, and preparing it for somebody else to manufacture, he would probably succeed commercially. If, for instance, he took the peat as prepared by Mr. Brunton, and submitted it to the gas distiller, he would get a useful product in the form of charcoal which was in itself more valuable than the peat before it was distilled; also another product in the shape of grease or tar, which he recommended them not to touch themselves, but to sell it to those whose business it was to treat those products, and who would get the greatest amount of commercial value out of them.

Mr. Heal said reference had been made in the paper to the Irish Peat Company. He had some knowledge of the formation of that company, but had never heard what its commercial success had been. It would, therefore, be interesting to him—if not to the meeting generally—if Mr. Paul would inform him what was the result of that undertaking after having been in existence, he believed, three years. It was projected by men of considerable standing and eminence, but he never heard of the company after it was launched, and did not know what had been the commercial result of it.

Mr. Newton said the Irish Peat Company started with the intention of getting everything out of the peat, and, consequently, they failed.

Mr. E. C. C. Stanford said, as one of the few who had visited the Lews establishment, and having, through the courtesy of Mr. Paul, inspected the works there, he would say a very few words on this subject. None but those who encountered them could form any idea of the difficulties of carrying out such a manufacture in those islands, where everything had to be imported—talent, and, no doubt, to a great extent, the workmen. Whether they looked at the population—their ignorance and prejudices, or whether they looked at the difficulties of drying the peat in the short season that was available for that purpose, they must regard it altogether as a work of great difficulty, though not insuperable. He was much struck, in looking over the factory, at the way in which the difficulties had been met and overcome, and he thought they were much indebted to Mr. Paul for the manner in which he had described the modes of obtaining paraffin oil from peat. The failure of the Irish Peat Company no doubt arose from what Mr. Newton had told them; but another reason for their non-success might be assigned. They adopted, amongst other things, a most powerful blast, an arrangement likely to blow the products of combustion, not into, but through the condensers, and it appeared that they lost ground very much in that particular point. Then, again, he considered the introduction of the fan spoken of by Mr. Paul a great improvement upon the Irish Peat Campany's process. This was a very excellent arrangement, and everyone who had noticed the difference between the steady working of a fan and the inconstant action of a chimney, would admit that the plan of Mr. Paul was a step in the right direction. The whole subject was one to which great attention should be paid, for we really knew less about these islands of the Hebrides than we did about our distant colonies. The Hebrides, the Shetland, and the Orkneys, at present produced very little to their owners. No doubt if their resources were properly developed—if the peat were worked, to which he would also add the seaweed—the land cleared of peat would no doubt bring a far greater revenue to the owners, who were not generally—though they ought to be—the first to carry out any great measures of improvement.

Mr. John Cassell said it struck him that, if the Irish Peat Company did not succeed in the production of paraffin oil, under the very favourable circumstances in which that company was placed, he did not see how success was ever to attend any operations for the production of paraffin, and paraffin oil from peat; for when the Irish Peat Company was in operation, the American petroleum had not been brought into the market. He did not see how it was possible for the manufacture of paraffin, and paraffin oil from peat, to compete with the petroleum. Here they had a product, furnished by nature, ready for distillation, and they knew it could be distilled at small cost. Mr. Paul had told them the quantity of paraffin that could be produced from peat, but he had given them no statistics as to the cost of distillation. They knew that there were many substances operated upon in this country which, through the introduction of petroleum, had now become almost valueless. Asphalte might be mentioned as an instance of this. A large company, with a capital of £100,000, was established for the purpose of bringing asphalte from Cuba, which was to be had for the cost of the carriage to this country; but it was found it could not compete with the petroleum, and at the present time circumstances were more than ever favourable to a cheap supply of that article. Hitherto the chief items were the carriage and freight. At the wells petroleum could be had at very small cost, and the price they paid for it in this country had been enhanced by the expenses of transit, but now the Atlantic and Great Western Railway of Canada had carried lines to the wells, by which means they anticipated a very large and cheap supply of petroleum in England. Then when they looked at the power of production, he observed that large manufactories had been established which were capable of refining thousands of gallons of petroleum daily. He could state that he was associated with works where 5,000 gallons of oil per day were distilled and refined at a small cost. Looking at the subject in a practical light, he could not see how it was possible, with the oil from Canada and America, to expect to produce anything like an article of equal value and so free from odour. He should like to elicit from Mr. Paul the cost of production of oil from peat, because the apparatus set in motion for the distillation of petroleum was equally applicable, by the addition of a few retorts, to the making of oil from peat.

Mr. Topham begged to recall the attention of the meeting to the very important statement made by Mr. Brunton this evening, that the peat prepared by him had been proved by experiment to possess a calorific power of two-and-a-third times that of coal. If that were actually the case, a complete revolution would take place in steam navigation, and the dividends of the companies would be increased to an enormous extent, seeing that by this means the cost of fuel would be reduced by fully two-thirds. He should be glad if Mr. Brunton would be good enough to give the meeting the data upon which he had arrived at the results he had announced this evening, viz., that 10lbs. of this peat would evaporate $2\frac{1}{3}$ cubic feet of water, as it was known that it required 10lbs. of coal to evaporate one cubic foot of water into steam.

Mr. Fothergill said having himself furnished the results of the experiments to which allusion had been made, he begged to state that a steamer was placed at the disposal of the parties by whom the experiments were made, and he had attended personally, accompanied by another engineer. Having ascertained what the consumption of the furnace in coal was for a given trip, they commenced getting up the steam with peat, and having weighed out an amount of peat equal to that of coal consumed, they started upon the trial, the result being exactly as stated by Mr. Brunton. Reference had had been made to the introduction of the blast while peat was undergoing a certain mode of treatment in Ireland. He had found that if any kind of peat were subjected to blast it disintegrated, and there was a great amount of consumption, but a poor result was obtained. If they could soften the draught in the chimney, the flame produced was of a very durable character, because the draught was not sufficiently strong to disintegrate the peat. He had tried experiments with it in locomotive engines. He had not a sufficient supply to test it against coal or coke in drawing a given load so many miles at a certain velocity, but he had seen sufficient to convince him that if they had a draught large enough to prevent the flame from disintegrating the peat, they would get a result which would be surprising to everyone. In the first experiment they had a blast of $4\frac{1}{4}$ inches diameter. He found that was too strong, and it drew the flame through the smoke-box, so that it escaped up the chimney without being made available for heating, which was the case in many instances in steamers. He, therefore, had a fresh blast pipe made of 5¾ inches in diameter, and the steam was generated better with the softer blast than with that 4¼ inches in diameter, and every engineer would know the wonderful difference which that alteration of the diameter of the blast would make.

Mr. Topham remarked that, upon the facts now stated, he did not think there was any justification for the assertion that peat possessed 2¼ times the calorific power of coal, and such a statement ought not be received upon the hap-hazard experiments which had just been detailed.

Mr. Brunton said the way in which the result was arrived at was this:—Taking 12 cwt. as the consumption of coal per hour, the same weight of peat was used, which kept up the steam for 2 hours and 20 minutes, maintaining the same quantity of steam, and doing the ordinary work of the engine for the increased period of time he had stated. His statement, he said, was fully borne out by the experiments of Messrs. Jackson and Townson, who had furnished a report to the effect that all the five samples of peat forwarded to them for experiment, possessed much greater heating power than coal, for while the latter took six minutes to bring a certain quantity of water to the boiling point, the same result was produced by the peat in from 1 to 1½ minute. The length and general character of the flame rendered the peat fuel very applicable to reverberatory furnaces. Mr. Brunton added that the importance of these results was enormous, with regard to steamboats, inasmuch as half the space now occupied by fuel would be available for cargo, and there was the further advantage of the absence of all dirt and dust in the case of the peat fuel, with entire freedom from smoke. Although he had spoken of the price of 5s. per ton, it was to be supposed that the manufacturers would require a little profit for themselves; it was not, therefore, to be taken that the fuel in question could be supplied at that price.

Mr. Paul, in reply to the enquiries and remarks of the gentlemen who had taken part in the discussion, said that as to the making of gas from peat he was not in a position to speak as to the chemical composition of the gas produced. He could only state the results of numerous trials made for the purpose of supplying gas for lighting at the works in Lews. Those trials showed that the peat gave a large quantity of gas of considerable illuminating power. It was sufficiently pure even to be burnt at once, as it came from the retort, and without any purification, and the peat appeared to yield as much gas, or even more, than the best kinds of gas or cannel coal. With regard to the signal failure of the Irish Peat Company's works, Mr. Paul said he considered this was attributable to the disproportionately large expenditure on the works, amounting, as he believed, to upwards of £60,000; also to the improper mode of treatment adopted in working the peat, and, above all, to the very inferior character of that peat, which, according to the results of chemical examination, obtained prior to the establishment of the works, was shown to yield only a very small proportion of oil and paraffin, about 3½ gallons from the ton of peat, while the actual working results gave only 2 gallons from the ton. The cost of the peat at these works was from 5s. to 7s. per ton; so that the cost of oil was upwards of 3s. per gallon, while the highest price that could be expected for the oil was only 2s. 6d. per gallon. Besides this the products which were expected to afford more than half of the profits of the works, were found not to produce more than one-eighth of what was calculated upon. Instead of being worth £12,700 a year, they were worth only £1,752, according to the Company's own returns; and they probably cost more than that sum for manufacture. On the contrary, the Lews peat, which he had spoken of, cost only 1s. 6d. to 2s. per ton; it yielded six or seven gallons of oil and paraffin per ton, and the cost of manufacture was such that these products could be obtained at a cost of about 1s. 6d. per gallon. This was an actual working result obtained from works on a small scale, working about seven or eight tons of tar a week, and carried on with all the disadvantages attending the commencement of such operations in a place where everything was more or less unfavourable. These facts, therefore, established a very great difference between the two cases; on the one hand they showed why the Irish works failed; on the other hand, they showed that the failure of the Irish works was no measure or indication of what might be done with peat of a better kind than that used at those works. As to the possibility of working peat for oils and paraffin, in competition with American petroleum, he would not venture to speculate on what might be the future state of the case with regard to that matter. Petroleum, and the manufacture of oils from it, were undoubtedly great facts, and would doubtless become of still greater importance. But at the present time the cost of crude petroleum was upwards of £15 per ton, or nearly 1s. 3d. per gallon, and there was a tendency to an increase of price. If that increase should take place, the possibility of working peat and other materials would be increased; but if the price of petroleum came down so low as £8 per ton, as was confidently predicted by some competent authorities, then it would undoubtedly drive every other material out of the field. As regarded the application of peat to fuel, and the statements brought forward by Mr. Brunton and other gentlemen, he was fully aware of the possibility of bringing peat into the condition of the samples which had been produced. He knew from his own experience that peat might be so prepared as to have, when dry, a density equal to coal, to yield a compact, hard coke, and to be suitable for making gas and coke and for metallurgical purposes. He would be one of the last to question this undoubted fact. But the question to which he had endeavoured to draw attention in his paper was the practicability of this proceeding as a commercial undertaking. This was the great, in fact, the only question. In the paper he had read, he had pointed out several circumstances which were inconsistent with practicability. Much had been talked about the use of peat in metallurgy, but he could not discover any such application of peat except where coal could not be got or could not be got at a suitable price. As to the remarks which had been made with regard to the fuel value of prepared peat, he was at a loss to reconcile the statement which had been made with the indisputable facts of the composition of peat as compared with coal. According to this, the full value of absolutely dry peat was about two-thirds that of coal. Coal would evaporate only ten times its weight of water, but, according to the statements made that evening, peat would evaporate upwards of twenty times its weight. This was a position so startling and inconceivable that it called for unquestionable evidence in support of it before it could be received as a fact. There was not a shadow of such evidence put forward, and Mr. Fothergill's remarks gave no account of the data from which such extraordinary conclusions had been drawn. The experimental estimation of the fuel value of this prepared peat, as referred to by Mr. Brunton, was obviously quite valueless, and could not for a moment be regarded as having any bearing on the question, or any kind of value whatever. Consequently, the only possible course was to reject the conclusions that had been come to as incorrect.

The Chairman was sure he only expressed the feeling of the meeting when he thanked Mr. Paul, on their behalf, for the very elaborate paper with which he had favoured them. The question of the manufacture of iron had been discussed in connection with the subject of peat; and, amongst other matters, the case of the Irish Peat Company had been brought forward. He believed if that company had succeeded in making coke from the peat, it would have proved a most profitable application of the material; but in that they had failed. It would appear, from the views expressed by several speakers, that the value of peat as a fuel for ordinary purposes depended upon its being of a sufficient density to stand the blast; and inasmuch as it was not usually obtained in a dense state, it had not been used to any extent as a fuel. He did not think it was generally known that there was a furnace constructed by Mr. Siemens, by which that difficulty was entirely avoided, and for that reason it was well adapted for the employment of peat. It had an exceedingly slack draught, far more gentle than was used in ordinary boiler furnaces, so that even the lightest peat would not be blown away. This furnace generated combustible gases from the fuel and burnt them, producing a great heat. Another part of the furnace produced a hot blast, and the several applications of those arrangements had given an intensity of heat which had not been obtained by any other means. He had been told by Mr. Siemens that on one occasion he had used peat in a furnace of this construction, and he (the Chairman) had very strong reasons for thinking that in this furnace peat would be found to be a valuable fuel for reducing iron from its ores. The most promising improvement in the manufacture of iron, he thought, consisted in the use of the gases from the fuel; instead of mixing the ore with the fuel with all its impurities, reducing the ore by means of the purified gas. He might add that Mr. Siemens' furnace made gas from peat in an exceedingly abundant manner, and at the same time he had an arrangement for producing an intensity of heat more than sufficient for the smelting of pig iron. With regard to the subject of the comparative heating properties of peat, he thought it would be a pity if the meeting allowed that question, which had long ago been settled, to be now re-opened by the experiments brought forward this evening, conscientiously made, as he had no doubt they were. He did not think they were justified in throwing aside the numerous experiments made by the most competent observers, which had shown that the heating power of peat, weight for weight, was considerably below that of coal. Under some circumstances it might be a more convenient fuel, and in many cases was known to get up heat very rapidly; but to admit its general superiority to coal as a fuel he thought would be a great mistake, as they had the best possible means of knowing to the contrary. He concluded by moving a vote of thanks to Mr. Paul for his able and valuable paper.

The vote of thanks having been passed,

The Secretary announced that on Wednesday evening next, the 3rd of December, a Paper by Mr. D. Puseley, "On Thompson's Process of Boatbuilding by Machinery," would be read.

The following letter has been received by the Secretary:

SIR,—I very much regret that a previous engagement will prevent my being present at the discussion on Mr. Paul's paper. I have read the proof with which you favoured me with the interest due to so able and clear a report of important and well carried out experiments and workings. The only remark I have to make is that, while adhering to an opinion expressed before the American and Canadian hydro-carbon oils had come into play, that portable light after going through a period, first of animal sources, such as sperm and seal oils and tallow, then of vegetable, palm, cocoa-nut, and rape oils, has now entered on a mineral period of liquid and solid hydro-carbons. I was quite unprepared to see so large a yield as 9 per cent. of valuable tar obtained from peat, and had always believed that Boghead and such like coals (if they be coals), as well as natural tars, like the American and Canadian crude mineral oils, to say nothing of the richer Rangoon petroleum, would render impossible the profitable extraction of artificial tar from peat. I am, &c.,

GEORGE F. WILSON.

Price's Patent Candle Company, Limited, Belmont,
Vauxhall, London, 25th Nov., 1862.

THE CHAIRMAN'S ADDRESS.

The following letter has been received by the Chairman of the Council:—

Spring-gardens, November 22nd, 1862.

MY DEAR SIR,—I find that in your opening address to the Society of Arts, on the 19th inst., you have, I have no doubt unintentionally, committed a mistake in the third page, where, in alluding to the late Mr. Walker's work, the "Bishop Rock Lighthouse," you say, "as a difficult and successful work, the Bishop Rock Lighthouse, off the Scilly Islands, may be placed in the foremost rank of engineering skill with those of Smeaton, at the Eddystone, of the elder Stevenson, at Bell Rock." Now, the real fact is, that the Bell Rock Lighthouse was designed by and built under the direction of my father, and the late Mr. Stevenson was simply the resident engineer, appointed at the recommendation of my father, and acting under his directions. These facts are established beyond doubt by the official documents which I have published. Trusting, therefore, that you will correct this at some future opportunity, I am,

Yours very sincerely,

JOHN RENNIE.

Sir Thomas Phillips, Chairman of the Council of the
Society of Arts.

Home Correspondence.

INTERNATIONAL EXHIBITIONS.

SIR,—I have carefully considered Mr. Chester's letter upon International Exhibitions, which was printed in your *Journal* of the 14th instant, and I hope you will excuse my troubling you with the following remarks upon it.

The first part of the paper is devoted to the inquiry whether the Commissioners of 1851 are bound to provide assistance to future International Exhibitions; but he carefully avoids the question whether they are bound to provide the deficiency which may occur from the Exhibition just closed.

It is not my intention to touch upon so difficult a subject, but it is clearly one which must engage the attention of the Commissioners, as well as of the Guarantors, should they be called upon for a contribution.

Mr. Chester then proceeds to state that the preservation of the present building is a necessary condition for future Exhibitions, and on these grounds:—that, if destroyed, it is idle to suppose a body of Guarantors will be found to incur the responsibility of erecting another structure, or that other Commissioners will be found to undertake the responsibility of management.

For the sake of the plan Mr. Chester subsequently propounds, for the future of Exhibitions, he is obliged to adopt these conclusions, but in which I fancy many will not agree. There can be no reason why, in ten years time, both Guarantors and Commissioners should not be found as easily as in 1861; indeed, I should say the experience of this year would rather facilitate the one and the other, for under most unfavourable circumstances, we have received £500,000, and the coincidence of this sum with that received in 1851 affords a good datum by which in future times to govern the expenditure; whereas, unfortunately, the sanguine expectations which were entertained of much larger receipts in 1862 than in 1851 led at first to the adoption of a scale of expenditure which will never be repeated, and afterwards to an economy bordering on parsimony; the uncertainty also which hung over the early arrangements led to many hasty and expensive measures which may easily be avoided in future.

Then, again, as leading up to the plan to be proposed, we are told, that besides the cost of ornamentation, and without the annexes, it is estimated that £100,000 would be required to complete the building—that is, I presume, to render it permanent; but I am assured this sum is below what would be necessary for such a purpose. With the exception of the picture galleries, the building has not an element of permanence about it, and they want one necessary and important feature—they are not fireproof. To make them so would cost a large sum, even if it were thought desirable to retain this portion of the building. Now, without wishing to disparage the building unnecessarily, I would ask who would approve this large expenditure on a building universally condemned, and which even the most determined supporters of the Commissioners can only justify by the circumstances under which it was erected, and which sum is within a trifle of the cost of the building in 1851.

Would not spending £100,000 or £150,000 upon it be throwing good money after bad, and preclude us from showing to the world 10 years hence that this building does not represent the national taste or the talent and ingenuity of our architects ?

If I am right in this view, we had better let it be sold at once for what it is worth; let the land revert to the Commissioners, and be available for the payment of whatever may be deficient in the receipts, to liquidate the entire cost of this Exhibition, and this, I believe, will be the most satisfactory termination of the present International Exhibition to the guarantors, to the public, and for our national character.

I might stop here, for the greater part of Mr. Chester's plans, as subsequently detailed, hang upon the maintenance of these buildings. If I have shown that, in the interest of future exhibitions, it is not desirable to maintain them, I have but little more to answer; but there are other views put forward,—as is the case with everything that originates from Mr. Chester,—with such force and skill, and which, in my opinion, are so erroneous, that I must notice them.

The first is " that International Exhibitions should be at shorter intervals than 10 years, and that in the intervals between them there should be smaller exhibitions."

I differ from Mr. Chester in respect of both these propositions.

International Exhibitions, to be successful, must be held at intervals long enough to shew marked progress in art, sciences, and manufactures in all parts of the world. Without this, interest sufficient to excite the curiosity of the nation and of foreign countries would not be attained, and unless it be probable that such progress can be exhibited and the world's curiosity excited, it will be impossible to induce many most important exhibitors—and without whose contributions the Exhibition as a whole would be a failure—to incur the unavoidable expense of exhibiting. It must not be forgotten that a large number of collections of objects are exhibited without any idea of profit, and that the expense and labour incurred in preparing them would not be repeated at short intervals.

Then, if there are to be frequent and smaller Exhibitions of articles to be carefully selected on the sole ground of their having merit, who is to take the responsibility of rejection, and what kind of merit is to ensure admission ?

Mr. Chester will reply, the Committees which he proposes to organise will decide these questions; but I venture to doubt whether any Commission formed as he contemplates would give nearly the satisfaction he anticipates. Then, to manage these smaller Exhibitions, he proposes an enormous machine, composed of Ministers of State, Commissioners of 1851 and 1861, Presidents of Councils of Scientific Societies, Presidents of Chambers of Commerce, Representatives of Industries, Universities, and Colonies, &c., &c., to a number together of several hundreds, who are to be assisted by " a *few experts*."

It is clear that this great organisation would soon resolve itself into a small Committee of Experts, who would not only fail to satisfy but would soon disgust every one with Exhibitions, National or International.

Then we are told this body might appoint jurors, who are to be paid by fees; but where the funds are to come from we are not informed; and I presume, from fees being provided for the jurors, every other member of this great Institute is to work gratuitously. I believe then that the idea of such a body acting to the satisfaction of the country is chimerical, and that whatever may have been the chaos in the management of 1851 and 1862, it would be infinitely worse in 1868, if besides the management of the proposed " little goes," the organisation of an International Exhibition in six years time were entrusted to it.

If little Exhibitions are wanted, they will be easily supplied; and surely the Crystal Palace is a good place for them ; but do not let us trifle with, or try to interfere too much with, International Exhibitions. Their exceptional character is one great element of their success; their suddenly calling into play a large number of new men, whose energies are devoted to a special object—has great advantages, and the very confusion which Mr. Chester dilates upon at such length, and I think exaggerates, evincing, as it does, the intense interest of the public, is not without benefit.

But there is a portion of the mis-management of this year's Exhibition which need not have occurred, and which the experience now gained will prevent for the futnre—I mean the almost entire exclusion from the staff of 1862, of those gentlemen who did good service in 1851. I will not mention names, but half-a-dozen will occur to everyone who recollects the proceedings of 1851, and whose services, had they been enlisted this year, would, I believe, have prevented many of the errors of detail which have arisen.

Now we have had the experience of two International Exhibitions, we do not want to establish an elaborate machine having only important duties to discharge, even according to Mr. Chester's plan, once in six years, either to enable us to avoid the errors of 1862, or to prepare for another to be held 10 or 15 years hence.

Having been led up to this new " Institute " we have another set of reasons assigned for doing something with this building after £100,000 or £150,000 has been expended upon it. If this expense be incurred, and we have annual Exhibitions, then, Mr. Chester says, we must have new roads and improved access to the building, so that the roads and accesses which have brought from 50,000 to 60,000 persons daily to this year's Exhibition are not, in his opinion, sufficient for the visitors to smaller annual Exhibitions. Without new roads we are told the value of the Kensington estate will depreciate, and that with them the value of the property of the whole neighbourhood will be incalculably increased. This last reason for the improvements suggested is easily understood, but surely the proposed Institute is not to enter upon such works in the interest of International Exhibitions and as an element of their financial success.

What, then, are the improvements suggested, and what will they cost ?

1. A direct road across the park. 2. The sale of the site of the Eastern annexe to any railway company which will make a railway under Hyde-park to the nearest station of the Underground Metropolitan Railway; and 3. A sunken road along the wall of Kensington-gardens.

These are certainly not inexpensive improvements to be undertaken with a view to retain the present building, and I venture to submit it would be far better and cheaper to destroy the building at once than to retain it at such cost. To uphold an unsightly building, which if pulled down can be adequately replaced when wanted, for £250,000, on such terms as these, appears to me to be as unwise as extravagant.

There are several other points in Mr. Chester's paper which I have not touched, but the length of this letter precludes my entering upon them.

I am, &c.,

WILLIAM HAWES.

THE CHAIRMAN'S ADDRESS AND THE FUTURE POLICY OF THE COUNCIL.

Sir,—The account of the proceedings of the meeting of the 19th inst., and the letter of your correspondent "Philip Palmer," which appeared in the *Journal* of last Friday, compel me to claim the insertion of this communication in your next number.

The nature of the address to be delivered on the above occasion is indicated by the 10th bye-law, to which I referred. It states that "the Chairman of the Council shall deliver an address to the Society at its first ordinary meeting after his election, declaratory of the policy which the Council propose to follow during its year of office." Five months having elapsed since the Council was elected, I remarked that the arrangement must be defective under which the policy of a year of office was not declared till nearly half the period had elapsed.

An important fact which I stated, but which is omitted in the report of my observations, is that the Council had no objection to the meeting to decide on a memorial of the Prince Consort for the Society when they thought (as they said) it would not be successful, but when they found that the members really took up the matter with great interest, and that the proposal was likely to be most successfully carried out by the members, the Council used every exertion to oppose it. The animus of the Council was clearly shown in their announcement, that they did not even approve of, or support the, resolution of the General Meeting, to the effect that they (the Council) should consider the most appropriate form of the Memorial, and bring it before the members at a fitting time. It is, however, only one of the instances in which the "presiding influence" of the Council has been made manifest, the uniform object of which is to limit within a chosen circle all proceedings from which any credit may be claimed for personal exertions, or devotion to certain objects.

I stated at the meeting that the address did not indicate the future policy of the Council. It might be very good in its way, but it was not appropriate to the occasion. I was unavoidably prevented from being present till a few minutes after the meeting had commenced, but I have since read over the address, and also the letter of your correspondent "Philip Palmer," and I am now more than confirmed in my views. Your correspondent styles himself "an independent member, of 33 years' standing." I also am an independent member of nearly 20 years' standing, and as such I am desirous of seeing not only an independent Council, but one which shall rest its claim to support, not on its exclusiveness, but on its open and candid reliance on the general body of members. I do not think the Council have to thank their champion for his attempt to defend them. Your correspondent admits that it is not improbable but that many members present at the meeting, and who had heard the address, may think that the doings of the past are more faithfully recorded than the future policy, and he says that no member of the Council pointed out the paragraphs referring to the future, though two of them followed me in the discussion. It is unnecessary for me to notice the few commonplace remarks of these gentlemen, as they had no reference to my observations, but I shall proceed to examine seriatim those indications of future 'policy' noted by your correspondent.

1. "The recommendation of a marble bust to the memory of the late Prince Consort." In what manner this is considered a point of 'policy' I cannot tell, unless it is that the Council intend to condescend to carry out the resolution of the General Meeting of members on this subject. It is the more gratifying to me that it should be so, because not only was I in a great measure instrumental in obtaining that expression of the wishes of the members, but the marble bust to be specially subscribed for is *part* of the plan I myself suggested last session, in a letter to a large number of the members. But, if I had heard that part of the address, I would certainly have alluded to it as not being at all a satisfactory settlement of the question. The Society is indebted to the Prince Consort for its present position, not only as a practical and scientific body of eminent national importance, but also for the exceedingly sound state of its finances. In addition to the bust, what could be more appropriate, and more in consonance with the Prince's own views, than the founding of an annual prize under his great name, for promoting the important objects of the Society? At present I shall not further allude to this, but I again simply ask in what way is the recommendation of the bust an indication of future "policy?"

2. "The hope expressed that his Royal Highness, the Prince of Wales, will accept the office of President." Independent of the fact that this is only a repetition of what was announced in the Council's address at the Annual Meeting in June last, when it was stated that the Council "have reason to hope that at an early period the Society may enjoy the honour and advantage of having His Royal Highness as their President," I again ask, is this an indication of their future "policy?" Besides, the election of President rests with the members, and not with the Council.

3. "The opportunity afforded by the renewal of the lease for rendering the building more adequate to the wants of the Society, and the library more easily accessible." This also is a repetition of what we were told in the June address, and it is too ridiculous to ask how such a subject can be called a point of future "policy."

4. "The acting on the precedent of 1852 in having no exhibition next year." This certainly indicates what the Council *don't* intend to do, and, as regards their future policy, is consistent with my view that they do not indicate what they *are* to do. Not doing that which has *not* been before, is scarcely all that constituents expect to learn from their representatives.

5. "The announcement of the papers at the evening meetings before Christmas." This forcibly shows the loss your correspondent felt for the topics in the address in support of his object. The "announcement of the papers" was made in the advertising columns of the *Journal* the week before the address was delivered, and I can scarcely think your correspondent was serious in alluding to it.

6. "The revision of the list of premiums so as best to meet the wants of the present period." This is very vague, and it seems strange that it should be necessary to point out that the Council intend to promote the objects of the Society in the way which enabled it to achieve so much good, but which has been much neglected for some time past.

7. "The intention of the Council to enlist the services of those members who are willing to take part in the work of the Society by assigning special departments of investigation to members classified with relation to subjects with which they have been familiarised by their callings or studies." I will not say that the Council intentionally introduced this into their address in a way to give an impression that they were thus voluntarily offering to enlist the active aid of members in promoting the objects of the Society, and thus appear to adopt a course which might gain them (the Council) popularity. But it is unfortunate for their champion that he should show himself to be so unacquainted with the *duties* of the Council, as to claim credit for them on a point on which they have no option. The 36th bye-law says, "The Council *shall* proceed, as soon as convenient after the Annual General Meeting, to form lists of those who may be considered specially eligible to serve with others on such Committees of Reference, as may be appointed from time to time. To these Committees the Council may refer for examination, advice, and report such discoveries, inventions, improvements, and novelties in Arts, Manufactures, and Commerce, and other matters as shall from time to time be brought under its notice," &c. In announcing this "intention," the Council only do what they are *bound* to do, and it was quite superfluous in them to

have declared that they intended to be governed by the rules of the Society. A large body of the members (and among them your correspondent) who are not acquainted with these rules, would, however, give credit for an indication of "future policy" to which the Council are not entitled as voluntarily emanating from themselves.

I am glad that your correspondent has drawn particular attention to what he calls the future policy of the Council, because it shows clearly the grounds on which they rely, and it has enabled me to prove their fallaciousness. It is not for me to indicate what the future policy of the Council ought to be, but there are important subjects I could name on which their intentions were looked for.

A member of the Council raised an issue which he must have known was not the true one. The object of the resolution was *not* to express the opinion of this Society upon the general conduct, character, and demeanour of the gentleman who had addressed them. It was simply to return thanks for the address, which in itself might be "interesting and excellent," but which I maintain was not appropriate to the occasion. I have not the pleasure of the acquaintance of Sir Thomas Phillips, except from meeting him at the Society of Arts, but I cordially and fully agree with all the remarks that were made respecting his gentlemanly and courteous demeanour on all occasions on which I have met him.—I am, &c.,

J. H. MURCHISON.

Surbiton-hill, Kingston-on-Thames,
November 26, 1862.

PROPOSED SUBSTITUTE FOR COTTON.

Sir,—The serious position of the Cotton manufacture of this country at the present moment endues with unusual interest every question relating to a future cotton supply, or to the discovery of materials capable of being substituted for cotton wholly or partly.

This being so, I am induced, sir, to request your permission to bring before the public, through the medium of the Society of Arts, a short account of a very remarkable source of fibre, with the character of which those who are most closely interested in this important subject ought, in my opinion, to become acquainted.

In September of last year there were brought to my laboratory, by a Mr. Ghislin, from the Cape of Good Hope, some specimens of the bulb of a kind of lily, indigenous to the country about the Cape, which yielded a cotton-like fibre, thought to be applicable to paper-making. I was instructed to make an examination of the bulbs with reference to that question, and, upon investigation, I found that they contained a large proportion of a fibrous substance closely resembling cotton, but rather finer in texture and very soft and silky. I was immediately impressed with the belief that this fibre might be found capable of being spun into thread, and of being applied generally, like cotton, to the production of woven fabrics.

The bulbs from which this fibrous material is obtained are but little known to botanists; they belong to the orders amaryllidaceæ and filiaceæ, but their variety is not well defined. The physical character of these bulbs differs in some respects from that of the common lily; they are closer and more compact in structure, and the layers or divisions of the root hold more firmly together, like those of the onion. The divisions are thick and fleshy, like the divisions of the bulb of the white lily, but this fleshy or parenchymatous mass is developed upon what may be termed a skeleton of fibres, which lie imbedded in the fleshy matter, and run from end to end of the division of the bulb, all lying in the direction of the long axis of the bulb, in a general sense, but interlacing laterally among themselves, so as to give great strength and firmness to the structure of which they make part. The layers of the root are thick and fleshy only when they are fresh; they shrink as they dry, and then the arrangement of the fibres can be traced very distinctly. The length of the fibres seems to be considerable, as, when the division of the bulb is carefully torn across, they can be drawn out slightly; they then separate, leaving soft loose ends exactly like cotton.

A second variety of this bulb, even more interesting in its character than the first, was sent to me by Mr. Ghislin, only a few months since. It closely resembles in most points that which I have described, but differs from it in one most remarkable respect: the fibres, instead of being straight and of a length not exceeding that of the division of the bulb in which they lie, are spirals, every fibre being coiled up in the direction of its length like a bell-spring; the consequence of this arrangement is, that when the layer of the bulb is torn through gently, so as to break the dried-up fleshy matter, but not the fibres, the latter can be drawn out, that is, the spirals can be straightened until they reach a length of 8, 10, or 12 inches. The fibre from this variety of the bulb is also very much finer than that from the first, being more like raw silk, showing a lustrous surface.

In October, 1861, I had one of the bulbs planted. It began to shoot out of the ground in November, and continued to grow during the winter, until it reached the height of about 16 inches; it threw up three long slender leaves, resembling those of the common flag. The leaves died down in March, and the root has remained in a quiescent state during the past summer and autumn, until within the last three weeks; at the commencement of the present month, however, it began to show itself above the ground, and has now pushed up a green shoot about one inch and a half in height.

It is stated by Mr. Ghislin that these bulbs grow in large quantity in the sandy wilds near the Cape of Good Hope, and that they could be cultivated without difficulty. The fibre is easily bleached, and it appears to me that it could be treated by any of the mechanical means employed in the treatment of cotton. I send you some specimens of both varieties of the bulb and some of the fibrous material obtained therefrom. I also send you my growing plant, as it might be an object of interest to some of the members of the Society.—I am, &c.,

THOS. W. KEATES, F.C.S.

Chemical Laboratory, 14, Chatham-place,
Blackfriars, E.C., Nov. 24th, 1862.

Proceedings of Institutions.

◆

Ipswich Mechanics' Institution.—The lecture-hall at the Mechanics' Institution, after undergoing extensive alterations and improvements, was re-opened in August by a morning meeting and an evening entertainment. The building was not by any means an old one, nor was it either inconveniently constructed or ugly, but unfortunately it suffered under such acoustic defects, that more than one professional lecturer had spoken of it as the worst hall in England for a man to speak or make himself heard in. It had a flat panelled ceiling, which was usually pointed to as the cause of the fault; and no contrivance which could be devised was ever found to effect any material improvement. An evil may be borne with for a long period, but a time usually comes when people determine to endure it no longer, and thus it has been with the lecture-hall. It got into a state to require a good deal of repair, and much cleaning and renovating, demanding a considerable outlay to put it into condition; and those who had the management of it had not the heart to spend the money needful for it, knowing that no amount of embellishment would avail against the unfortunate defect of its construction. Mr. Thomas Shave Gowing, the Chairman of the Committee, whose long devotion to the interests of the Institution is well known, ventured at that crisis to look at the matter in a bold spirit. He shrank from spending money upon cleaning and redecorating the surface of the old ceiling, for he felt that every sovereign so laid out might be available towards a real improvement in the hall. He had considered the matter, and had examined other buildings for years, with a view to the ultimate remedy of the fault of the lecture-hall, and he had become convinced that a roof open to the ridge, with plenty of timber upon the beams, would be all that was necessary. With the assistance of Mr. Phipson, he designed a plan for the improvement; he set on foot a subscription among the members and friends of the Institution, raising, almost entirely by his own exertions in that direction as much as £197, and, with the sanction of the Committee, set about the task of improving the hall on the plan he had conceived. The alterations have been going on for some months, and during the whole of that time Mr. Gowing has been there watching the progress, and directing the details as they suggested themselves, and the consequence has been that the improvements have been carried out step by step, like a a work of art, every advantage being made the most of, and the minutest circumstance turned to account. Other important improvements were introduced beside the alteration in the roof, and some needful work to other parts of the Institution buildings was done at the same time. The labours of the Chairman of the Committee and the expenditure of the money of the members are well paid in the result. The acoustic defect has been entirely removed, and it is now an excellent room to speak and hear in. The appearance of the interior has been improved as well as the convenience of the building. There are now two good entrances to the hall, one for front seats and one for back seats, with a sub-divisional entrance for the gallery. Handsome doors and doorways have been built in both cases, which are an improvement to the street. A new room has been erected over the upper entrance, for the accommodation of lecturers. Another entrance to the gallery has been made from the lobby on the reading-room side of the building, and the alterations effected in building the staircase have made a very important improvement in the reading-room itself, affording increased light, ventilation, and accommodation. In the hall itself a new, handsome gallery front has been introduced, and an excellent alteration has been made to the lecturer's platform. The improvement of the roof alters the entire character of the room. Light and ventilation are now obtained from both ends of the building. The colours used in the decoration were selected by Mr. Gowing, and are admirably assorted and contrasted. The hall is now 38 feet high from the centre of the floor to the ridge of the roof, and it is said that 14,000 cubic feet of space is added to the interior. It is now called the lecture and music hall.

To Correspondents.

ERRATUM.—In the last number of the Journal, page 14, col. 1, line 13, for "100 millions" read "1,000 millions," and line 15, for "30 millions" read "300 millions."

MEETINGS FOR THE ENSUING WEEK.

MON. ...Geologist's Association, 7. Mr. Tomlinson, "On some Processes in the Useful Arts as Applied to the Explanation of Certain Geological Phenomena."
British Architects, 8.
Medical, 8½. Dr. James Bird, "Public Hygiene (concluded). Means of Ameliorating the Physical and Moral Condition of the Masses."
Royal Inst., 2. General Monthly Meeting.
TUES. .. Civil Engineers, 8. Mr. A. W. Makinson, "On some of the Disturbing Forces of Locomotive Engines."
Ethnological, 8. 1. Mr. J. Wright, "On the Human Remains found in the Excavations at Wroxeter." 2. Mr. J. Crawfurd, "On Languages as a Test of the Races of Man." 3. Mr. E. Preiss, "Some Remarks on the Aborigines in Australia."
WED. ...Society of Arts, 8. Mr. D. Puseley, "On Thompson's Process of Boatbuilding by Machinery."
Geological, 8.
THURS...Chemical, 8. 1. Dr. Woods, "On the Estimation of Organic Matter in Drinking Water." 2. Mr. Rodwell, "On the Reactions of Sulphate and Sulphide of Lead with Hydrogen and Carbonic Oxide."
Linnæan, 8. 1. Mr. Mellor, "A Naturalist's Journey to the Capital of Madagascar." 2. Dr. McIntosh, "Food and Parasites of Salmon." 3. Dr. McIntosh, "Shore-Crab."
Royal, 8½.
Antiquaries, 8½.

PATENT LAW AMENDMENT ACT.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette November* 21*st*, 1862.]

Dated 14*th July*, 1862.

2026. O. P. Drake, Massachusetts, U.S.—A new and useful or improved apparatus for vaporising and aerating a liquid hydrocarbon to be burned for illumination or for other purposes.

Dated 22*nd September*, 1862.

2588. J. Long, Gorleston, Great Yarmouth—An improved machine for cleansing and scraping streets, roads, or ways.

Dated 21*st October*, 1862.

2840. C. Trees, Blackfriars-road, and F. C. Belhomme, New-street, Covent-garden—Imp. in hats, caps, bonnets, and other coverings for the head.

Dated 23*rd October*, 1862.

2853. A. Chaplin and G. Russell, Glasgow—Imp. in obtaining fresh water by evaporation, and in apparatus therefor.
2857. M. C. A. Perkes, Belvedere-house, Rosendale, Dulwich—An equilibrium, double-action revolving rudder, self-balancing drag, and improved steering gear. (A com.)
2859. H. Donald, Johnstone, Renfrew, N.B.—Imp. in machinery or apparatus for bending or straightening metal plates.
2861. J. Field, Lambeth—Imp. in steam engines, condensers, and boilers.

Dated 24*th October*, 1862.

2863. A. J. F. Vigneulle-Brepson, 30, Boulevart de Beaumarchais, Paris—A siphoidal cistern, with water reservoir for kitchen or other drains in communication with infected sewers.
2865. L. Groux, Victoria Soap Works, near Sheffield—Imp. in the manufacture of soap, and in machinery for that purpose.
2867. J. R. Nicholl, Streatham, Surrey—An improved construction of fire-place or stove grate.
2870. P. S. Devlan, Buckingham-street, Strand—Imp. in the manufacture of bearings, steps, axle boxes, and other surfaces and appliances or articles subjected to friction.

Dated 25*th October*, 1862.

2873. W. Owen, Rotherham, Yorkshire—Imp. in stoves.
3875. D. Brown and W. Brown, Smethwick, Staffordshire—Imp. in-rolling machinery for rolling gun barrels, cannons, and other articles.
2877. W. Clark, 53, Chancery-lane—An imp. in the construction of the joints of cast iron gas and water mains and other pipes. (A com.)
2879. P. Alfraise, 51, Rue de Malte, Paris—Imp. in sewing machines.
2880. T. G. Ghislin, Hatton-garden—Imp. in the treatment and utilisation of certain foreign plants, for the obtaining of useful fibres therefrom.

Dated 27*th October*, 1862.

2883. J. Chattwood, Bury, Lancashire—Imp. in ventilating rooms and cellars.
2885. J. H. Johnston, 47, Lincoln's-inn-fields—Imp. in heating glass furnaces. (A com.)
2887. F. Lipscombe, 233, Strand—Imp. in purifying water.
2891. J. J. Ridge, Thomas-street, St. John's, Southwark—Imp. in treating certain farinaceous substances applicable to infants' or invalids' food, and in apparatus to be employed therein.
2895. T. Richardson, Newcastle-upon-Tyne—Imp. in the manufacture of sulphate of soda.

Dated 28*th October*, 1862.

2897. J. Chalmers, 8, Knight's-place, Wandsworth-road, Vauxhall—Imp. in armour plating ships of war and fortifications.
2091. H. Allen, St. James's-place, St. James's-street—Improved apparatus for preparing leaves and stalks of plants for being cleaned or dressed for the purpose of obtaining the useful fibres they contain.
2903. E. S. Tudor, Upper Thames-street—Imp. in the purification of lead.
2905. J. Jeffreys, The Rise, Hoddesdon, Herts—Imp. in constructing surface condensors, and apparatus for heating and cooling fluids.

Dated 29*th October*, 1862.

2907. A. Ripley, Brook-street, West-square, Lambeth—Imp. in the construction of pistons for steam engines, which improvements are also applicable to air and liquid pumps.
2908. A. Shanks and F. Kohn, 6, Robert-street, Adelphi, Westminster—Imp. in hydrostatic presses.
2909. G. Darlington, Minera, Denbigh—Imp. in the manufacture of zinc oxide.
2911. A. Hogg, Londonderry—Imp. in smoothing irons.
2913. W. Clark, 53, Chancery-lane—Imp. in the treatment of copper ores, and in apparatus for the same. (A com.)
2914. I. W. Lister, J. Bottomley, and W. Bottomley, Well-oth-lane, Rochdale—Imp. in looms for weaving.
2915. W. Cooke, 26, Spring-gardens, St. Martin's-inn-the-fields—Imp. in apparatus for ventilating.
2917. W. E. Gedge, 11, Wellington-street, Strand—Improved apparatus in connection with the pans of waterclosets. (A com.)
2919. D. Fryer, Carlton-square, Old Kent-road, and J. W. Meears, Annett's-crescent, Islington—Imp. in casks, tanks, or other receptacles for containing petroleum and other oils or spirits.
2921. J. Unsworth, Rochdale-road, Manchester—Imp. in steam engines.

2923. H. P. F. Newham, Nottingham—Imp. in the manufacture or production of reversible shawls.
2924. J. Fletcher, sen., Leeds, and J. Fletcher, jun., Newcastle-on-Tyne—Imp. in forming wrought-iron wheels, and in tools and apparatus for making the same.

Dated 30th October, 1862.

2925. J. Lockwood, Batley—Imp. in boilers.
2927. F. Gregory, Manchester—Imp. in presses for pressing seeds, fruits, hops, and other substances.
2929. J. Eaton, King's Norton, Worcestershire—An imp. or imps. in the manufacture of certain kinds of gas burners for illuminating purposes.
2931. P. Giffard, 66, Boulevart des Batignoles, Paris—Imp. in air guns and other air arms.
2933. J. Birch, New Norfolk-street—Improved apparatus for unstopping or clearing from obstructions, drains, water closets, stack, water, and other pipes.

Dated 31st October, 1862.

2937. W. R. Bowditch, St. Andrew's, Wakefield—Imp. in carburetting or naphthalising gas, and in the apparatus employed therein.
2938. H. L. Corlett, Inchicore, Dublin—Imp. in the construction of tuyeres.
2939. G. Dickinson and E. Cooke, Smethwick—Imp. in the construction and ornamentation of metallic bedsteads, couches, and children's cots.
2941. A. Andrews, Birmingham—An improved tool for cutting and rasping pegs in boots and shoes.
2943. G. H. Morgan, Hereford—Improved mechanical arrangements for raising and lowering bodies.
2945. M. C. de Casteras Sinibaldi, 1, South-villas, South-street, Greenwich—Imp. in the manufacture of armour plates for ships, fortifications, and forts, and in the manufacture of plates to be used in the construction and building of ships, and for attaching copper or other like protective metal to the outside of metal plates for making copper bottoms, or bottoms with a similar protection to iron ships, and for other purposes.
2949. W. E. Newton, 66, Chancery-lane—Imp. applicable to the carriages and beds of guns, mortars, and other ordnance. (A com.)
2951. J. G. Marshall, Leeds—Imp. in the treatment of the straw of flax, hemp, and other similar vegetable substances preparatory to spinning the fibre thereof.
2953. J. J. Anderson, St. James-street, Northampton—A new or improved mode and means for the production of leather from waste leather scraps, and also for producing from such waste leather scraps in combination with india rubber, gutta percha, or other like substance, a new material to be used as leather, and for other purposes.

Dated 1st November, 1862.

2955. J. W. Taylor, Newsome, near Huddersfield—Imp. in scouring or cleansing woollen, worsted, and cotton fabrics and other fibrous materials, and in the means or apparatus employed therein.
2961. J. Winter, jun., Wardour-street, Soho—An improved safety tap or cock applicable to gas burners, gas pipes, and vessels containing gas; also water pipes, steam pipes, and vessels containing inflammable and other liquids, compressed air, and spirituous liquors.

Dated 3rd November, 1862.

2963. J. Musgrave, Bolton-le-Moors, Lancashire—Imp. in the valves of steam hammers, and steam, hydraulic, and gas engines.
2965. L. Gonez, 15, Passage des Petites Ecuries, Paris—A seat or chair, forming also a travelling bag for the use of travellers by rail or other way.
2966. F. Trachsel and T. Clayton, Manchester—Imp. in machinery or apparatus for obtaining light, heat, and ventilation, parts of which improvements are also applicable to other purposes.
2967. G. Hollins, Manchester—Imp. in the manufacture of straps or belts for machinery.
2971. D. Scattergood, Nottingham—Imp. in circular frames for the manufacture of looped fabrics.
2972. P. F. C. Cheveron and E. C. Eichenberg, Paris—A new method of, and apparatus for weaving Indian shawls and other figured tissues.
2973. R. A. Brooman, 166, Fleet-street—Imp. in machinery for moulding and compressing artificial fuel, peat, bricks, tiles, and other substances. (A com.)

Dated 4th November, 1862.

2975. J. B. Francis, Hullard-hall-lane, Stretford, near Manchester—Imp. in apparatus for raising and lowering window blinds, maps, and other articles, and for retaining them in position.
2976. J. Lefebvre, 54, Rue des Tournelles, Paris—A new or improved instrument or indicating angles or variations of level, and for measuring horizontal and vertical distances.
2977. F. Durand, Paris—An improved cotton gin.
2979. J. H. Johnson, 47, Lincoln's-inn-fields—Imp. in hanging, arranging, and operating ordnance. (A com.)
2981. J. Place, Over Darwen, Lancashire—Certain imp. in looms for weaving.
2983. T. Huntley, Manchester—Imp. in kitcheners and kitchen ranges, and in cooking and bath heating apparatuses.
2985. J. Shirt, Tamworth, and C. Briggs, Alders Mill, Tamworth—Imp. in apparatus for condensing the steam of high-pressure steam engines.
2987. A. C. Dewies, Nicholl-square, Aldersgate-street—An improved lubricator.

Dated 5th November, 1862.

2989. J. B. Thomas, Paris—Imp. in apparatus for working and controlling railway signal discs.
2991. J. Banwell, Watlington, Oxfordshire—Imp. in apparatus for punching by means of hydraulic pressure.
2995. R. A. Brooman, 166, Fleet-street—Imp. in spinning frames. (A com.)
2007. A. V. Newton, 66, Chancery-lane—A new process of obtaining printing surfaces, dies, and substitutes for photographic negatives. (A com.)
3001. J. J. Laveissère, 58, Rue de la Verrerie, Paris—Imp. in the manufacture of tubes of copper or other metals or alloys.

Dated 7th November, 1862.

3010. C. O. Heyl, Berlin—Improved means and machinery to be used for the purpose of extracting fatty oils from oleaginous seeds, and for purifying the said oils, and for extracting the agents employed from the exhausted residue.
3012. A. V. Newton, 66, Chancery-lane—Imp. in repeating fire-arms. (A com.)

Dated 8th November, 1862.

3016. H. Kilshaw, Haslingden, and E. Lord, Rawtenstall, Lancashire—Certain imp. in power looms for weaving.
3018.' C. W. Spruyt, New Broad-street—Imp. in rails for railways.
3022. G. Kent, High Holborn, and E. P. Griffiths, High-street, Camberwell—Imp. in apparatus for reducing cocoa berries and other vegetable and animal substances to powder or pulp, and for mashing potatoes.

Dated 10th November, 1862.

3026. J. Whitaker, Leigh, Lancashire—Imp. in machinery or apparatus for pulping, stripping, and slicing edible roots for cattle.
3028. S. Berrisford and W. Ainsworth, Stockport—Certain imp. in looms for weaving.
3930. R. J. Chapman, South-street, Camberwell—Imp. in the manufacture of glass and emery paper or cloth.
3032. W. E. Newton, 66, Chancery-lane—Imp. in the treatment of maize or Indian corn preparatory to grinding the same into flour. (A com.)
3034. T. G. Ghislin, Hatton-garden—Imp. in the treatment of certain foreign plants and in the application of the fibres derived therefrom.

PATENTS SEALED.

[*From Gazette, November 21st*, 1862.]

November 21st.

1509. J. Eastwood.
1541. J. H. Perry.
1543. G. Crawford.
1559. J. Ward and J. Dewick.
1569. M. Walls and J. Crompton.
1570. J. Taylor.
1585. J. Ireland.
1591. J. Duffus.
1614. G. Ashton.
1620. W. Clark.
1643. R. Shortrede.
1665. E. Lloyd.
1678. G. Peel and J. Simpson.
1760. C. A. Tyler.

[*From Gazette, November 25th*, 1862.]

November 25th.

1595. H. Eaton,
1597. J. H. Kidd.
1600. C. Cohen.
1602. R. Martindale.
1603. T. Turner.
1605. J. Hirst, jun., and E. O. Taylor.
1606. R. A. Brooman.
1611. J. Hirst, jun., and J. Wood.
1617. C. D. Abel.
1619. J. Paterson.
1621. N. Lawton and R. P. Whitr worth.
1634. W. Eddington, jun.
1637. A. Gilbey.
1639. G. Ermen and R. Smith.
1640. W. T. Smallwood and W. Wright.
1641. A. Moreau and A. E. Ragon.
1654. B. Templar.
1662. C. E. Gray.
1722. A. J. Joyce.
1754. M. Jackson.
1787. J. Hunt.
1820. D. Adamson and L. Leigh.
2062. A. Cotelle.
2431. J. B. Thompson.
2432. Sir W. O. Brooke.
2506. W. Richards.
2565. W. Glass.
2582. L. Dixey and G. Smith.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

[*From Gazette, Novembert 25h*, 1862.]

November 18th.

2624. J. Petrie, jun.
2646. R. Mushet.
2680. T. Watson and G. Healey.

November 19th.

2757. F. Coignet.

November 20th.

2645. C. G. Hill.
2666. W. Smith.

November 21st.

2668. T. Carr.

November 22nd.

2663. A. Hubart & V. Cantillon.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

[*From Gazette, November 25th*, 1862.]

November 19th.

2618. D. S. Price and E. C. Nicholson.
2619. D. S. Price and E. C. Nicholson.
2645. J. Jobson.
2659. F. Coignet.

November 20th.

2631. J. Roberts, jun.

November 21st.

2637. C. T. Dunlop.

November 22nd.

2653. C. Sanderson.
2664. J. Clark.
2687. R. A. Brooman.